Industrial Power and Lighting Issue

Electrical World

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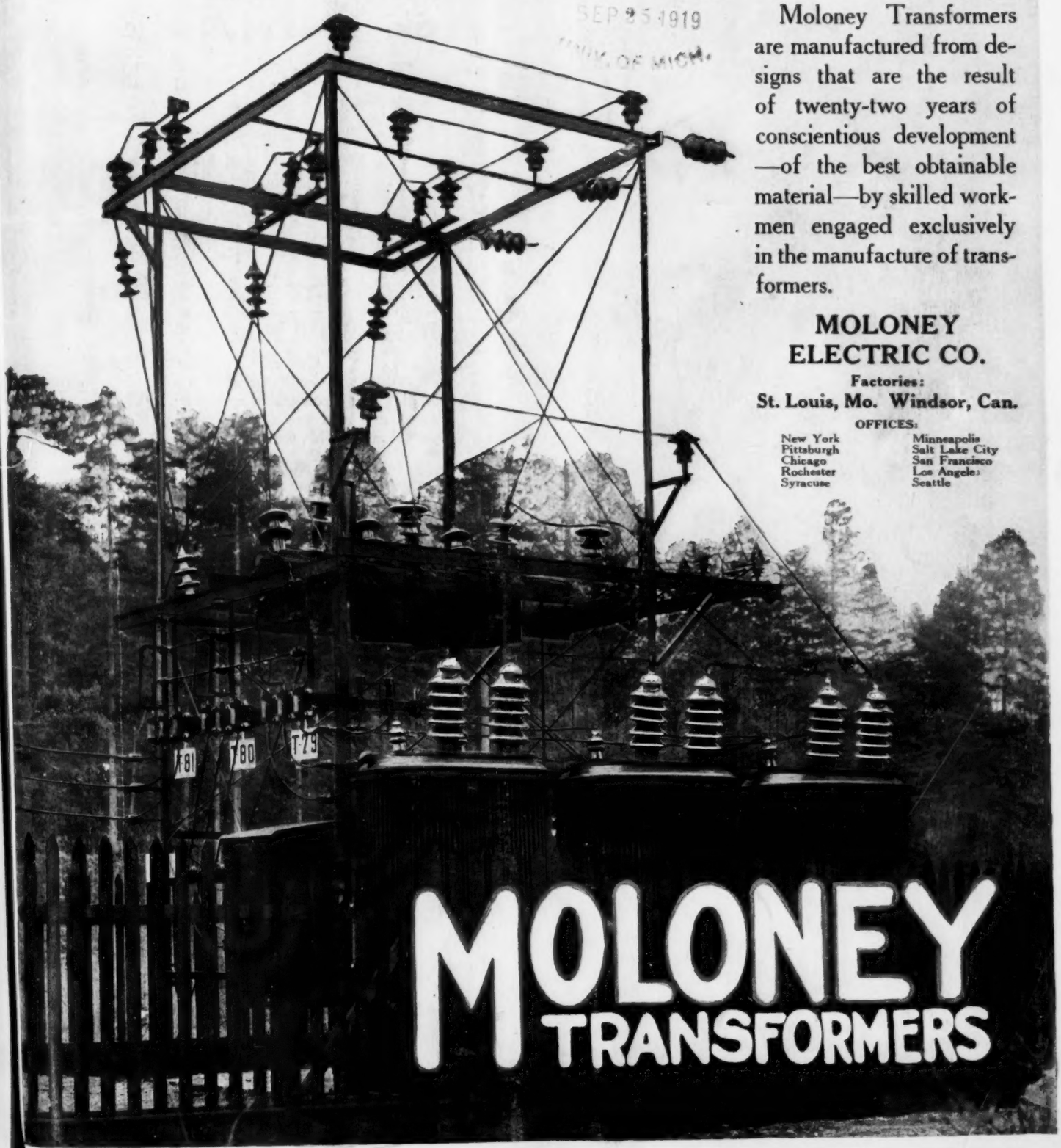

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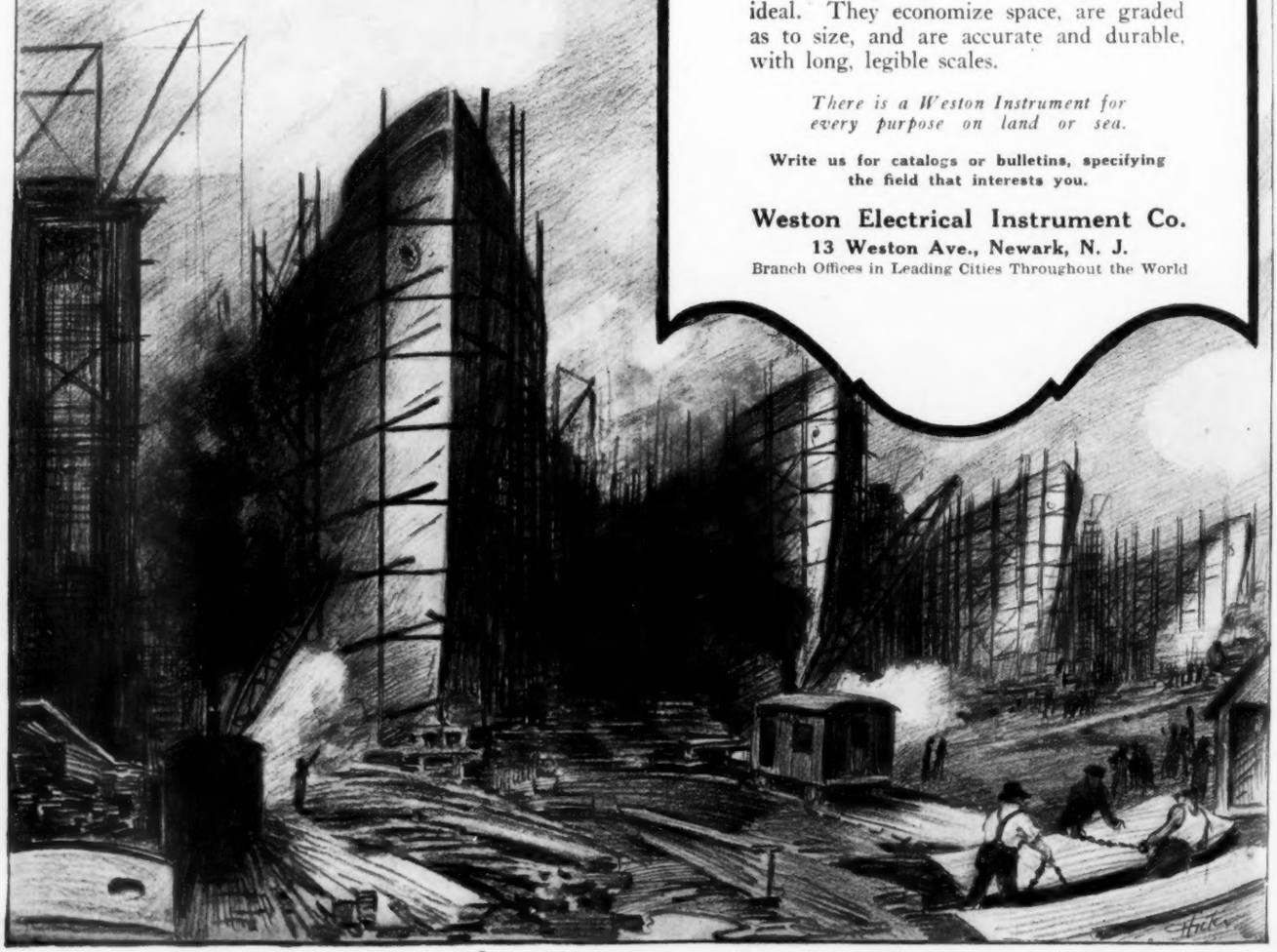

Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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Beating Swords Into Plowshares

OF THE many plants which have been turned from industries of war to those of peace, few present more interesting details than the great East Springfield shops of the New England Westinghouse Company. Starting with a big contract for Russian rifles, the work of the plant was more and more fully utilized by our own government after entering the war, and before the armistice was signed it was one of the chief sources for machine guns and was turning out these weapons at the rate of 10,000 per month. Its rifle production rose to a maximum of 100,000 in a month. With the end of hostilities came the vital question of future work, and the whole equipment has now been remodeled for the production of small motors. From rifles and machine guns it has passed to washing-machine motors and ignition sets. The Springfield plant, from the nature of its work, was built without the electric crane equipment necessary for the manufacture of heavy machinery, hence the change to small-motor production was a logical one. The old installation, like the new one supplied from the local central station, was on the group-drive plan. The new one is of individual drives with about 700 motors from ¼ hp. to 100 hp. in capacity and aggregating about 2500 hp.

The present equipment was the result of a very careful study of the requirements of the situation. A thorough examination was made of the necessary sequence in the operations of building small motors and number and kind of machine tools, and, this done, floor plans of various departments were prepared and the layout of the tools worked over until the material in process could be passed through the shop in the simplest possible way. In providing a new equipment many of the tools were such that they could be very readily fitted with individual drive, either by provisions already made or by simple additions. The engineering department of the Pittsburgh works then gathered full data for the sizes of motors and the control equipment required, so that the new works were early in possession of full information.

Energy is received from the hydroelectric station at Bircham Bend, at 5500 volts, and is delivered to two individual substations near together and close to the center of distribution. From these power is distributed at 440 volts to the working secondaries. The lighting load, like the power load, is subdivided between the substations, and in addition a synchronous motor-generator set in one substation provides 230 volts direct current for a certain number of adjustable-speed motors needed in the plant. In addition to the motor service required there is a full equipment of electric coil-baking ovens, some of them ingeniously arranged to use electric heat for the automatic regulation of the temperature, while the main heating is derived from a steam supply. The reëquipment of this large plant for the works of peace is a most excellent example of careful engineering, and it need scarcely be said that the specialization of output in small motors is one which must lead to good results in economic production.

Reliable service can be jeopardized only at the peril of the central-station industry. In some quarters engineers are tempted to cut investment at the expense of regulation, but let no one gamble on the industrial consumer's placid endurance of shut-downs at present labor and material price levels. Eternal vigilance from bus-bar to front-line meters must be the order of the day!

Industrial Research

INDUSTRIAL self-analysis, the study of the internal characteristics and tendencies of an industry, is not only helpful but to most executives has become an essential. As a somewhat recent development there has come also the desire to know more of the external relations of the industry. In this connection, while certain lines of investigation must necessarily remain the function of the individual concern, some are inherently so broad that they interest the entire industry and can better be undertaken and accomplished by coöperative effort than by the work of a single operator. For example, the larger electrical manufacturers have carried forward extensive programs of commercial research, compelled by many competitive influences to know as fully as possible their economic position. But the electrical industry includes not only the manufacture of equipment but also the producer of energy, the engineer and designer, the jobber and the contractor. For this larger electrical industry the ELECTRICAL WORLD has undertaken a program of statistical and economic industrial research, of which the first results are presented in this issue.

The purpose of the pioneer article is to show the extent to which each of the great basic manufacturing industries is dependent upon energy, the relation of the cost of that energy to other manufacturing costs, and the degree to which the energy requirement is met by electric power. The division of business between purchased and generated electrical energy and between electrical and mechanical power possesses the greatest significance both to manufacturers of equipment and to producers of energy.

It is proposed to follow this article by others of a similar nature, which will bring out further details of the relation of the electrical industry to other lines of industrial effort. These analyses will rest not only on information collected by government and state statistical agencies but on a comprehensive industrial survey now being organized by the ELECTRICAL WORLD.

Performance of Electric Furnaces

TWO of our papers this week deal in a highly practical way with the performance of electric furnaces, a subject which is rapidly growing in importance. One of them gives some exceedingly interesting details of the performance of the Heroult furnaces of the Connecticut Electric Steel Company in making tool and ordnance steel of the highest quality. The company in question has in all a connected load of some 2000 kw. obtained from the Hartford Electric Light Company, and it not only runs a pair of 2-ton furnaces for melting and refining but ovens for core baking and heat treatment, besides using a large amount of energy for cranes, grinders and miscellaneous machinery. Experience has shown the advantage of electric steel furnaces in rapidity and uniformity of work and in that thorough control of the melt which results in a product of exceptionally high grade. These advantages more than offset the modest extra cost of energy thus applied. Perhaps the most striking evidence of the advantages gained may be found in the experience of this plant in preparation of No. 3 ordnance steel for the United States Army. The specification called for 80,000 lb. per square inch ultimate tensile strength and 36,000 lb. per square inch elastic limit. The steel delivered from the electric furnaces overran the specification on tensile strength by more than 10 per cent and that on the elastic limit by more than 40 per cent. More than this, the phosphorus and sulphur came down to less than half the maximum permissible under the specification.

The perfect control of temperature conditions in the electrical process gave not only better steel throughout but a more uniform output than could otherwise have been expected. In the last six months of 1918 a million and a half pounds of this ordnance steel has been melted and refined. The input of the furnaces is a maximum at the start while the actual melting proceeds, and then the power input is dropped in two stages until the final brief period of superheating. One of the heavy expenses of the process is the wear and tear on the electrodes, amounting to about 66 lb. (30 kg.) per gross ton of steel melted.

The electric core-baking oven, which is a valuable auxiliary, takes about 30 kw. and is used cheaply at night when an off-peak rate can be obtained. The temperature control being automatic, no care is required except for the watchman to close the main switch at a particular time and to open it at another. In addition to this equipment a special furnace for the heat treatment of steel is now being erected, intended to accommodate 1500 lb. (680 kg.) of castings and, like the core-baking furnace, automatic in its temperature control, being normally held at 850 deg. to 900 deg. C. An electric welding equipment has also been in use with excellent results, especially in the repair of steel castings which might otherwise have been scrapped.

The second paper, by R. N. Blakeslee, Jr., deals with the induction furnace in the making of brass billets. The particular furnace considered is of the Ajax-Wyatt type, which is essentially a transformer with a one-turn secondary formed of a loop in the charge itself. The cross-section of the channel which forms the secondary is a little over 2 square inches (13 sq. cm.), and when filled with molten metal the resistance is such that the flow is about 10,000 amp. The primary input is about 35 kw. at a power factor of 80 to 90 per cent. This construction gives some curious and interesting properties to the furnace. The energy consumption is moderate, the labor cost low and the mixing of the metals especially thorough. This last factor is due to the repulsion effect in the two sides of the heating loop, which sets up circulation in the molten conductor. Then, too, the zinc loss in the electric furnace is only about one-half of 1 per cent.

There are, however, some countervailing disadvantages, such as the necessity of continuous operation on account of the breaking of circuit if the metal cools too far. Certain mixtures cannot be worked advantageously, nor can a considerable change in mixture be made without the production of scrap. The operation of starting is a decidedly interesting one. The loop is formed by a brass core assembled in the refractory material, which after thorough drying is fired, and then a supply of power at reduced voltage melts out the brass pattern and the charge can be gradually added in proper amount. When properly handled the brass billets produced seem to be much superior to those made by ordinary firing, being closer to the mixture, with better surface and better grain.

Limitation of output at a time like this is a symptom of industrial insanity. Workers in every productive field must renew their efforts regardless of the instant pecuniary reward, secure in the knowledge that time will bring easier living costs as commodity stocks multiply. In this way the individual net earnings as well as those of organizations may be increased.

Outfitting for Motor Drive

AS A GENERAL rule individual motor drive is a step taken in equipping a new factory or in refitting an old one with new machinery. The expense of a direct change to individually driven machines is usually too great if the existing machinery is in good condition, in which case the tendency is toward a carefully adapted group drive. This latter method of utilizing motors is under proper circumstances extremely effective, the criterion between group and individual drive being in general that the driven groups shall constitute operative units. We present this week an account of changing over machines for individual drive which we think will be of very direct interest to our readers. The point of the situation was in dealing with machines which were themselves operative units and consequently for the most convenient results required individual drive.

The power required for the operation of each machine was on the whole small, generally from 0.5 hp. to 1 hp.—obviously a case where the choice would have to be made between the ordinary operation by shafting and separate motor, since the use of the units, considering their size, is such as to leave no advantage in the group arrangement. Consequently the machines were all made over for motor operation. The motors themselves were of the induction type, operated on the local 60-cycle circuit, and were all of one speed—1800 r.p.m. Because of the small size of the units most of them could be connected directly to the lines, so that the wiring equipment was simple. The illustrations show well the way in which the adaptation for the new drive was made. In practically every case the motor was attached either directly or by straps to the frame

of the machine. Only in some few cases was it necessary to cut away any of the base to reach a convenient location for the motor, and in every instance the equipment was kept thoroughly out of the way and the belt drives worked out in very simple fashion. The upshot of the change is that, with twenty-four motors on a total rating of 26.5 hp., the monthly energy consumption is only 1900 kw.-hr. This gives an average input of about one-third the total rating, which furnishes load factor not bad for a plant of this kind. All in all, the installation is an excellent example of successful adaptation for motor drive at very moderate expense.

Too many people in this great country can read and write for Bolshevism to be able to drag the Stars and Stripes in the dust; but unless all "100 per cent Americans" act and preach the gospel of production the cost of tuition in the school of reconstruction may be painfully high. Every one who aids in the adoption of electrical methods in industry is doing literally invaluable work for society in these critical times.

The Industrial Power Business

THAT at the present time industrial power is steadily increasing in importance as a source of central-station revenue is a fact of common knowledge, yet few people realize the very great extent to which in the last few years motor service has grown. The analysis of records of nine large central stations which we publish this week shows very plainly that to-day industrial power is a major source of revenue. The nine stations in question sold in 1918 a little under 300,000,000 kw.-hr., of which more than 60 per cent was for power purposes. The aggregate revenue from power was about $3,500,000, and the total per capita kilowatt-hours per annum rose to 272. Much of this motor business was due directly or indirectly to the war conditions, but there are as yet no signs of a serious decrease, as the experience has brought greater familiarity with the good points of electric drive. One effect of the uncertain needs of war-time activities and the necessity of hurried installations was to produce a very notable amount of over-equipment in the rating of motors. This will be the pest of the central station so long as it has to sell power on a kilowatt-hour basis, and it is as well the cause of loss to the consumer both in first expenditure and in operating costs.

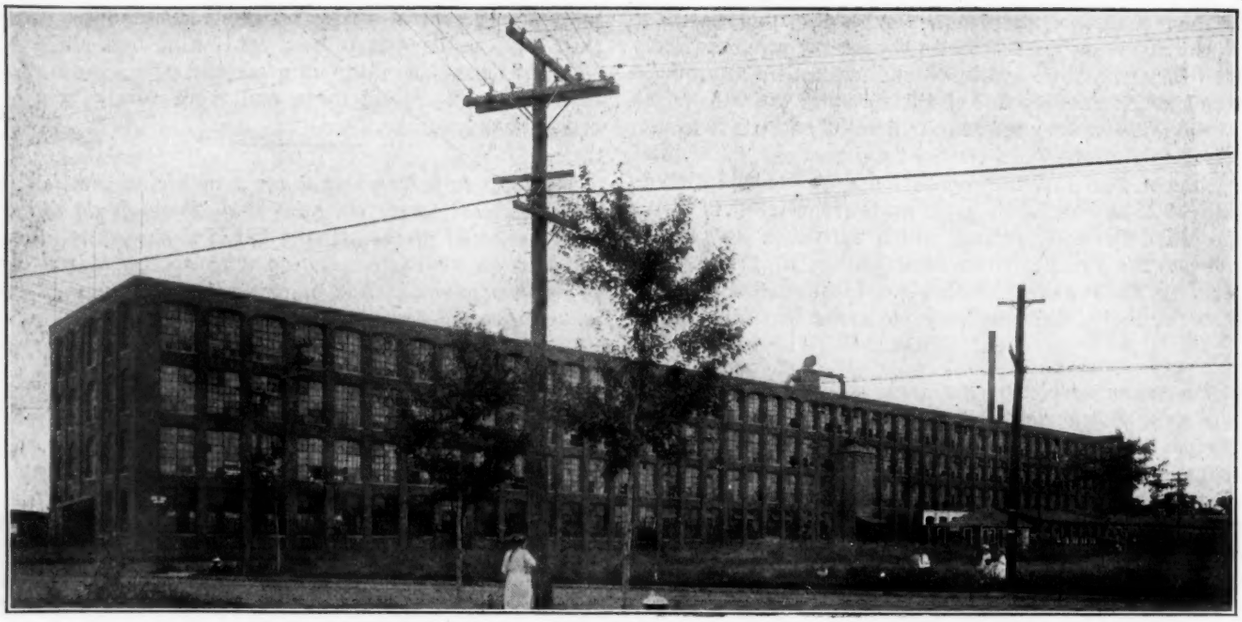
In the case before us the total rated power load was nearly six times the average reckoned on a twenty-four-hour basis, showing a very great loss to the user and bad load conditions for the central station. It would be interesting to know the average power factor of the installations concerned, which must have been very seriously affected by the underloading. It is clear that a systematic effort to improve motor equipment is necessary. The user certainly does not want to suffer from the low efficiency of his motors, and the central station is almost equally interested in avoiding the low power factor which constitutes so heavy a burden on its capacity. That motor drive pays both central station and consumer is thoroughly shown from the rapid growth of the business and the fact that the average price per kilowatt-hour of power sold was materially less than two cents. The tables printed show something of the details of the situation and furnish abundant evidence that industrial power is rapidly becoming the mainstay of central-station business. There is no doubt that this condition is to be a continuing one, since the cost of fuel is still on the up grade and power generation on a large scale will more and more firmly hold its economic advantage.

Running a private plant or a municipal station at excessive cost to satisfy local pride is no doubt within the legal right of the owners, but it is exceedingly poor business when interconnection with a reliable and less expensive central station or transmission service can be advantageously arranged.

The Organization of Electrical Inspection

THE paper by C. A. Cowdery on this very pertinent topic gives the methods and results obtained in a plant operating about 500 motors aggregating more than 9000 hp. and running twenty-four hours a day. Constant operation of this kind, of course, is a considerable strain on the reliability of the apparatus, and exceptional care in the upkeep is necessary to prevent interruption of production. A total of seventeen shutdowns in such an equipment during four years of operation tells, without further comment, the story of the efficient inspection maintained. To reach such results no small amount of forethought is necessary. To begin with, it seems to be good practice to use as few makes and sizes of motors and starting apparatus as the conditions permit. This greatly simplifies, of course, the matter of spare parts, and, what is more to the point, it requires the maintenance force to devote all its attention to only a few types, and therefore it is easy to become very thoroughly acquainted with them. The policy was inaugurated of carrying out, on the whole, a weekly inspection on Sunday, the only day when the plant was shut down, with enough of the regular and maintenance force on hand to facilitate inspection, the schedule being arranged so that the services of the same men were not required on every Sunday.

It was found desirable, too, to have the inspections recorded on a time clock so that there is definite record of the time at which each piece of apparatus was gone over. If at any time minor trouble occurred, notice was promptly given the maintenance department in order that the proper men might at once investigate the situation, thereby often obviating further and more serious trouble. The complete record kept both certifies to the work done and gives valuable information as to the weak points which may be found in the equipment. The frequency of inspection, of course, is determined by the class of apparatus and its use. Stand-still inspections necessarily have to be carried out in brief periods when work is not in progress, but regular inspections of bearings, temperature, lubrication and general condition were carried out daily on all the motors. Every week or every month, as the case might be, during a stand-still inspection the clearance between rotor and stator was tested and new bearings were supplied if necessary. Every two months the compensators and relays were inspected and tested, and circuit breakers and safety switches were similarly inspected once a month. A useful detail in keeping track of the fuse equipment is the painting of the shells of the fuses of different sizes in individual colors so that they can be instantly recognized. The organization chart annexed and the forms used are self-explanatory and show the thoroughness of the system.



Adapting Munitions Plant to Peace-Time Work

Electrical Changes Which Were Involved in Converting New England Concern to Motor Factory—Individual Drive Supersedes Group Installation—Method of Making Distribution System More Flexible

WITH a war production of 1,250,000 rifles, 50,000 Browning machine guns, 2200 air-craft guns and 200 tank guns, the New England Westinghouse Company of Springfield, Mass., terminated its work and turned its factory at East Springfield over to the Westinghouse Electric & Manufacturing Company for peace-time service. In place of death-dealing products the plant is now delivering small motors for domestic use. The machinery which once was driven to the limit represented by 5000 new rifles per day stands silently awaiting its disposition by the government, useless for the most part in the present tasks of the establishment and cumbering floor space soon to be occupied by entirely different equipment. Such a transformation of plant involves electrical service changes of importance, in order that production efficiency may be maintained on a high plane. An outline of these, with illustrations of how the problem of individual motor driving has been solved in the new installation, is given below.

The East Springfield plant buildings occupy about 300,000 sq. ft. (27,000 sq. m.). The factory was built about seven years ago for automobile manufacture, but was purchased early in the war by the New England Westinghouse Company, which had a contract from the Russian government for 1,000,000 rifles. The United States government utilized the plant more and more after America entered the war, and at the time the armistice was declared the establishment was one of the most important sources of machine-gun production in the country. It is interesting to note that in twenty-one working days after the drawings were delivered the plant was turning out Brownings, and that no less than 10,000 of these machine guns were manufactured, tested and delivered at the plant in October, 1918. The maximum production attained in rifles was 100,000 in one month. About 5000 employees were on the payroll at the maximum period.

The close of the war brought up the problem of future work at the plant, following the completion of its munitions contracts. The Pittsburgh factory of the Westinghouse company was overloaded, and a thorough study accordingly was made of the possibilities of East Springfield. As the latter plant was designed and built without electric crane facilities, production in the existing buildings is limited to material which can be handled by industrial electric trucks, conveyors and by individual or group effort. Although the plant is far east of the center of distribution of the country, it was found that electrical apparatus could be manufactured in it at competitive prices, and ample space is available on the property for expansion. Railroad facilities are excellent and the local labor market is good. Central-station energy operated the factory as a munitions plant and under the new régime is being supplied from the same system by the United Electric Light Company of Springfield.

The factory is now producing small motors, chiefly for washing-machine driving, and will shortly begin the manufacture of motors for automobile starting, ignition and lighting sets. The normal monthly output will be 15,000 small motors, 15,000 automobile starting and lighting units and 15,000 ignition units. About 300 employees were at work in the plant in mid-August, but the force is being rapidly increased, and about 1200 employees will be engaged in the near future. Ultimately from 2500 to 3000 employees will be required to handle the output of this factory.

The revision of the plant involved not only the removal of specialized machinery unfitted for the products now contemplated but the adaptation of an established building layout to processes entirely different in character from the previous routine. The plant was literally full of government machinery group-driven by 149 constant-speed three-phase induction motors with

a combined rating of 3112 hp. It was decided to make the new installation so far as possible a model in individual driving, requiring 750 motors ranging in size from ¼ hp. to 100 hp. on the machine tools and including a number of adjustable-speed direct-current motors to drive tools which did not have mechanical speed-changing incorporated in the design. The approximate connected load of the new motor installation, including air-compressor and other auxiliary machinery, is about 2500 hp.

As soon as the type of apparatus to be manufactured was determined a study was made of the sequence of operations required and the time involved per operation. The type, size and number of machine tools were thus determined. Floor plans for various departments were then prepared, usually to the scale of ¼ in. per foot, and machine-tool layouts were determined by cardboard templets representing the outline of the projected tool area, in rectangular form. Different combinations of operations were thus considered in the endeavor so far as possible to avoid retracing the ground covered by material in process. (Fig. 6.)

A great many machine tools on the market are so designed that direct motor application can be made in a satisfactory manner, therefore when purchasing new tools this feature is given careful consideration and preference given to the machine so designed that motors can be applied, provided that the mechanical features of the machine are equal. The adoption of individual motor drive for the new installation permitted maximum flexibility in tool arrangement—an advantage which would have been difficult to obtain with group-drive overhead motors and line shafting. The majority of the tools were purchased especially for the new work. However, some were brought from the Pittsburgh or Newark factories of the company and a few are machines that were used in the plant during the war but which could be used for service in the reconstructed installation. In the great majority of cases the war equipment will not be utilized in the plant. With one exception no group driving is retained; in general these were machines that were brought from the East Pittsburgh or Springfield works.

After the tools had been located by templet in a given department or section of the factory, photostat copies of the drawings or blue-prints were made and turned over to the various construction branches of the organization. The size of motor and the control equipment required for tool driving were determined in this case by the works engineering department of the company at East Pittsburgh. These data were transmitted to the East Springfield organization, which incorporated them on the photostat reproductions of a given factory subdivision. From these the size and arrangement of distribution circuits were determined. During the preliminary work of laying out tools for the production of small motors and automobile starting equipment the engineers of the company redesigned the starting, lighting and ignition system produced by the Westinghouse plants, and this entailed considerable changes in the arrangement of tools and also in the number and type of tools supplied to the East Spring-

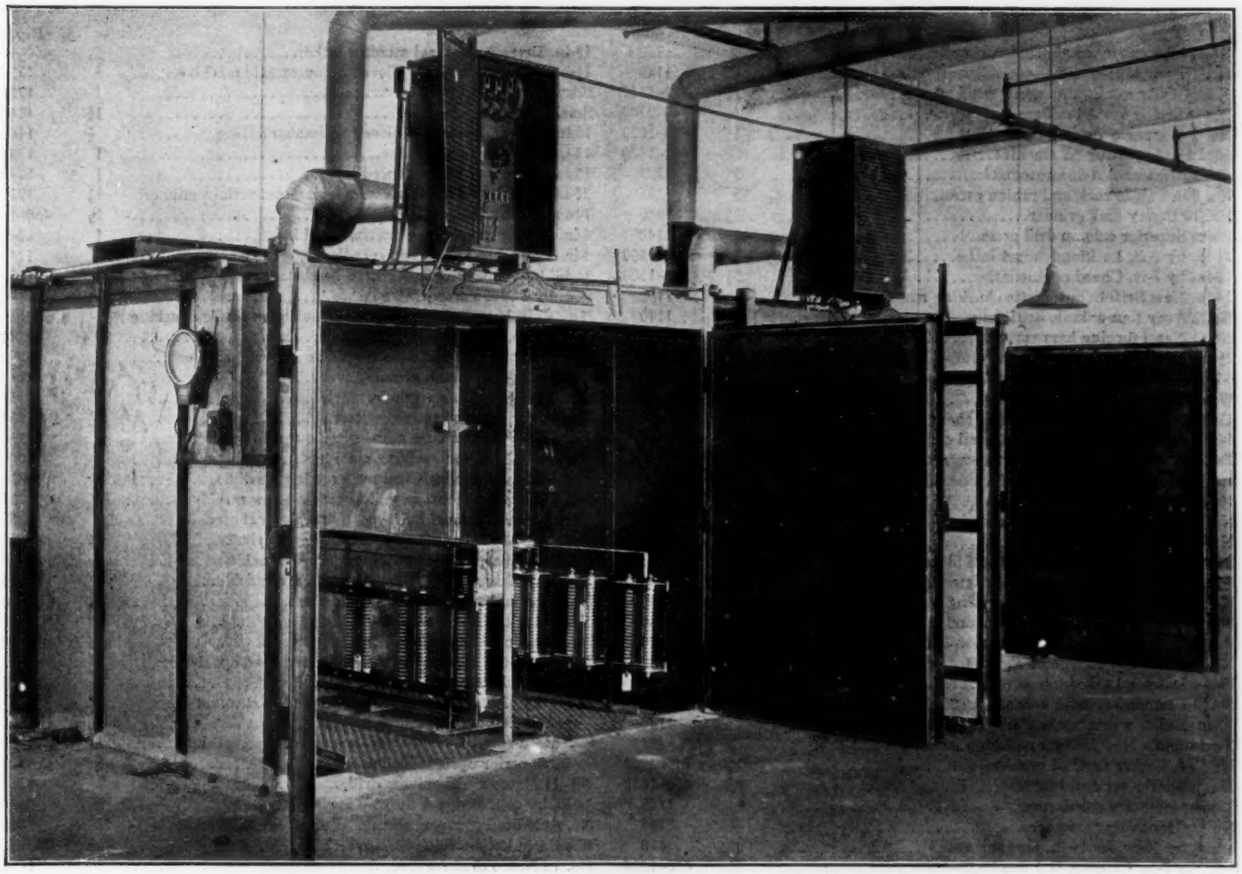


FIG. 1—COMBINATION STEAM AND ELECTRIC OVEN FOR COIL BAKING
Push-button control, automatic temperature regulation and recording, and door-contact control of grid circuits

field factory. Here the use of the individual motor drive proved its value in enabling production to be organized efficiently in spite of the congestion threatened by the overstaying of government machine tools on the premises and the rearrangement of operations necessitated to handle the new product satisfactorily. About this time, too, it became necessary to increase the capacity of the plant from a planned production of 8000 small motors per month to 15,000. The ease with which individually driven tools could be added and relocated under these conditions was greatly appreciated by the plant officials.

The accompanying table gives the sizes of a number of representative machine tools and motors in the plant, as installed for individual driving.

MOTOR ARRANGEMENTS USED DURING WAR

The typical motor installation in the plant during the war consisted of an actual layout of one 25-hp., three-phase, 440-volt induction motor for each floor section of from 1600 sq. ft. to 1800 sq. ft (145 to 160 sq. m.). In building "A," where the principal machine work was done upon rifle barrels, the shop is 508 ft. (155 m.) long, and was served by lines of 2-in. (5-cm.) iron conduit carried along the ceiling near the longitudinal central axis, the average spacing between junction boxes being about 50 ft. (15 m.). Each of these pipe lines contained two three-wire No. 1/0 circuits, and the pipe runs were extended down the shop far enough to reach the various groups of motors supplied, but were not all carried through to the end of the building. The usual arrangement was to carry a three-phase No. 1/0 lead from the junction box to Westinghouse type E starters mounted in pairs on a convenient column, No. 6 wires being carried from these to each motor. The starters were equipped with type H overload relays. The motors usually averaged to drive four lines of machines each, covering a shop section about 60 ft. (18 m.) long. The standard line shafting was $2\frac{7}{16}$ in. (3.6 cm.) in diameter, with 16-in. (24-cm.) drop hangers.

This arrangement had the merit of permitting a fair amount of sectionalization in the driving of groups of similar machines. The use of many motors of the same

REPRESENTATIVE MACHINE-TOOL INDIVIDUAL DRIVES—TYPICAL MOTOR AND TOOL RATINGS

	Motor Hp.	R.p.m.
No. 10 Bryant internal grinder, countershaft spindle 750....	5	1120
No. 2 Avey sensitive drill-press (two spindles).....	1	1140
No. 4 Warner & Swasey screw machine.....	2½	450–1180
No. 2 Becker vertical miller.....	1½	740–2200
No. 2 Warner & Swasey screw machine.....	1½	450–1800
6-in. Davis cutting-off machine.....	7½	400–1600
No. 72 National Acme automatic.....	5	1725
No. 856 Toledo rack and pinion press.....	15	1155
No. 10 Besley disk grinder.....	7½	1740
20-in. Superior column drill press.....	2	1140
21-in. by 8-ft. Le Blond turret lathe.....	7½	50 0–1500
18-in. by 7-ft. Chard engine lathe.....	5½	500–1500
24-in. New Britain automatic chucking machine.....	5	1130
No. 2 Avey four-spindle drill press.....	5	1140
No. 3 Nazel forging hammer.....	10	1140
2½-in. by 24-in. flat-turret lathe (Jones & Lamson).....	3	1130
4-in. Pratt & Whitney spline milling machine.....	1½	450–1800
Wisconsin hand-milling machine.....	1½	740–2200
13-in. by 6-ft. Willard semi-quick change geared lathe.....	2	1140
14-in. by 10-ft. Hendey geared-head engine lathe.....	2	1130
Two-spindle Jones & Lamson flat-turret lathe.....	7½	1740
16-in. by 10-ft. Hendey geared-head engine lathe.....	3	1130
30-in. King boring mill.....	5	1725
No. 4-A Stiles adjustable bed press.....	3	1120
No. 2 Avey three-spindle drill.....	2	1140
24-in. by 24-in. by 6-in. Cincinnati planer.....	5	850
3-in. by 18-in. Norton plain cylindrical grinder.....	3	1120
No. 2 Detrit semi-automatic drilling machine.....	3	1120
No. 1 Cincinnati universal cutter and tool grinder.....	2	1140
20-in. Rockford column drill press.....	2	1140
No. 13 Brown & Sharpe universal tool grinder.....	2	1140
No. 4 Diamond grinder heads.....	2	1140
No. 3 Diamond grinder heads.....	1	1140
12-in. Builders grinder heads.....	1	1140
Two-spindle New Britain polishing jacks.....	7½	855
No. 2-A Becker vertical profiler.....	1½	740–2200
No. 3 Becker vertical profiler.....	2½	450–1800
Two-spindle Avey drill press.....	1	1140
No. 2 Grant rotary riveter.....	½	1725
16-in. by 10-in. by 14-in. air compressor.....	100	870
1-in. by 7-in. Cincinnati Acme hand-screw machine.....	1½	450–1600
1½-in. by 8-in. Cincinnati Acme hand-screw machine.....	2½	450–1800
9-in. Sundstrand high-duty manufacturing lathe.....	1½	1140
24-in. by 39-in., 15-ton Lucas power forging press.....	2	1140
14-in. by 6-ft. Le Blond geared-head lathe.....	3	860
No. 2-A Brown & Sharpe universal milling machine.....	5	850
80-in. Bradley rubber-cushioned helve hammer.....	7½	1130
Leland-Gifford drill press.....	½	1725
6-in. Pratt & Whitney vertical shaper.....	2½	450–1600
2-in. Pratt & Whitney spline milling machine.....	3	1140
15-in. Potter & Johnson shaper.....	1½	450–1600
No. 2 Sellers drill grinder.....	3	1740
No. 12 Natco multi-driller.....	3	1740
24-in. New Britain chucking machine.....	5	1140
No. 2 Universal tool grinder.....	3	1140

	Motor Hp.	R.p.m.
18-in. Dresser universal monitor lathe.....	2½	450–1800
1½-in. by 10-in. model B Cleveland automatic machine.....	3	1730
Slack abrasive metal cutter.....	1	1725
Small power forming roll.....	1½	1140
10-in. by 5-ft. Pratt & Whitney toolmaker's lathe.....	¾	1140
14-in. American speed lathe.....	1	1140
12-in. Warner & Swasey speed lathe.....	1	1140
22-in., 8-in. by 12-in. abrasive machine-tool surface grinder..	1½	1725
14-in. by 6-ft. Monarch lathe.....	1½	450–1800
4-in. Whiton revolving centering machine.....	1	1140
4-in. Pratt & Whitney two-spindle centering machine.....	¾	1140
14-in. by 6-ft. Springfield geared-head standard lathe.....	2	1130
9-in. by 12-in. Porter-Cable lathe.....	1	1140
No. 3-254 New Britain automatic multiple spindle chucking machine.....	10	1140
No. 53 Acme automatic multi-spindle screw machine.....	5	1725
6-in. by 32-in. Norton grinder.....	5	1130
3-in. by 18-in. Norton grinder.....	3	1130
No. 613 Toledo power gang slitter.....	7½	855
No. 52 Acme automatic multi-spindle chucking machine.....	3	1720
1-A Milwaukee plain milling machine.....	3	860
No. 1-M single-pulley Cincinnati milling machine.....	3	1730
No. 515 Acme automatic multi-spindle screw machine.....	3	1730
Three-drum National hoisting engine, for coal service.....	30	855
10-in. by 24-in. Landis plain self-centered grinder.....	7½	855
Brown & Sharpe "CC" automatic screw machine.....	3	1730
Brown & Sharpe "OOG" automatic screw machine.....	2	1725
No. 1 inclinable open-back Toledo press.....	1	1140
No. 2½ inclinable open-back Toledo press.....	2	850
No. 6 inclinable open-back Toledo press.....	5	850
7-in. by 5-in. Ingersoll-Rand belt-driven compressor.....	5	1725
12-in. Heald rotary grinder.....	3	1130
1½-in. by 2-in. Davenport multi-spindle automatic screw machine.....	3	1730
Seventeen-spindle, eight-way Defiance drilling machine.....	5	1130
21-in. Superior upright drill press.....	3	1720
No. 11 Natco multi-spindle drill.....	3	1730
14-in. by 6-ft. Lodge & Shipley engine lathe.....	2	850
No. 4120 Stoll squaring shear.....	10	860
Wisconsin hand-milling machine.....	1½	740–2200
No. 12 Natco driller.....	3	1730
No. 12 Natco multi-tapper.....	3	1730
No. 23 Logerman scrap-metal baler.....	25	1130
No. 4-A Stiles back-geared press.....	5	1130
73½-B Bliss straight-side press (roller feed).....	7½	850
Continuous-type paint-baking furnace.....	3	1130
Cincinnati universal high-powered milling machine.....	5	1130
6-in. by 32-in. Norton plain cylindrical grinder.....	5	1130
Stoll No. 436 power squaring shear.....	5	850
No. 30 B. F. Sturtevant exhaust fan.....	3	1130
Porter-Cable engine lathe.....	1	1140
No. 9 Shuster straightening and cutting machine.....	3	1130
No. 22 12-in. Heald rotary surface grinder.....	3	1130
No. 600 Connersville blower.....	2	1140
No. 2 Troy type Sirocco fan.....	1	1140

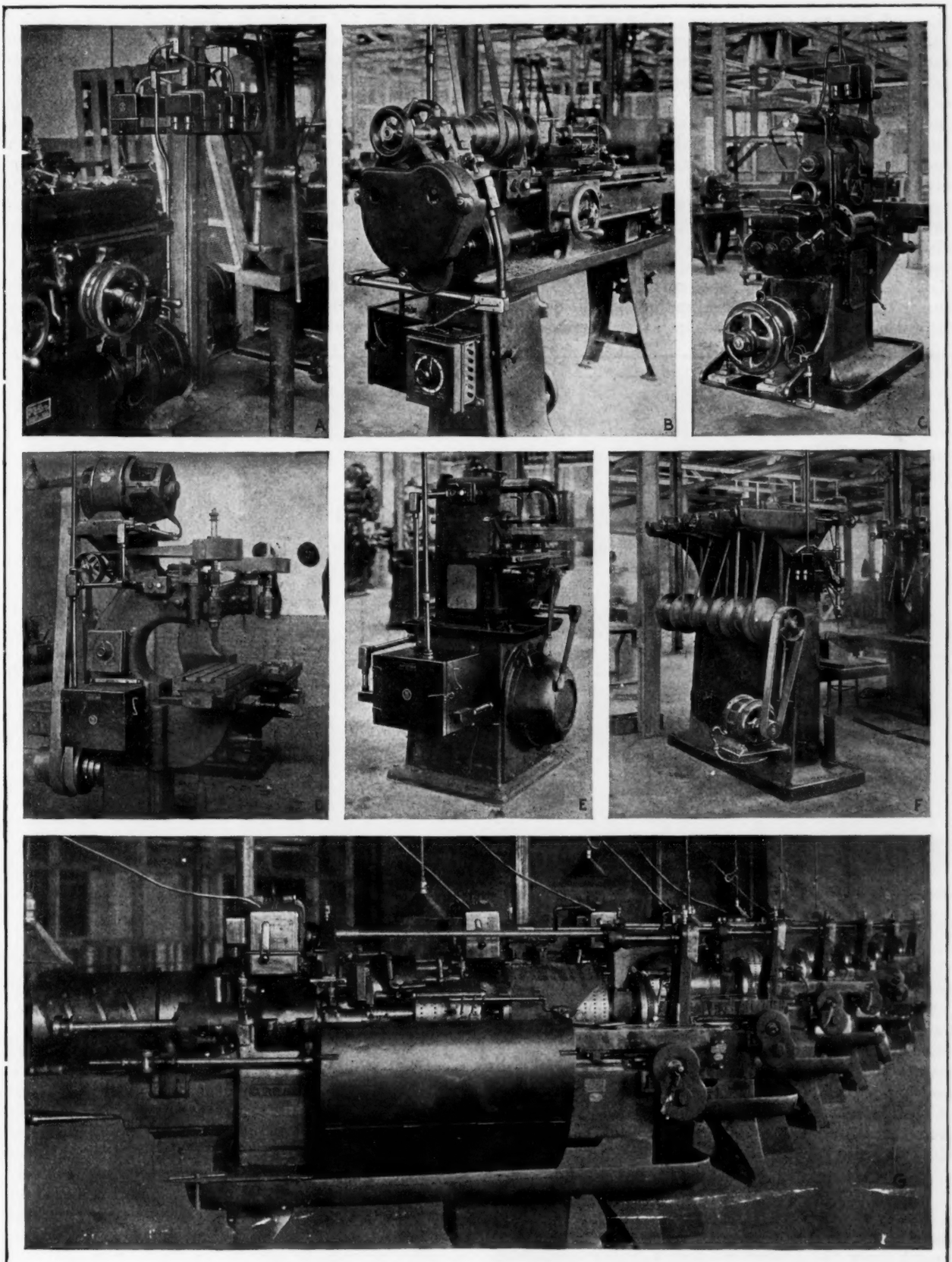


FIG. 2—MOTORS AND CONTROL—INTEGRAL PARTS OF MACHINES

A—Four starting switches fed from one conduit; armored cable feeds motor. B—Push-button control for adjustable speed motor overhead. C—Direct-drive motor mounted on bracket to clear floor when washing; starting apparatus on top of machine. D—Adjustable-speed direct-current motor on bracket above working plane. E—Motor housed by machine pedestal; starting box in foreground and push-button control above. F—Motor mounted on bracket and adjustable for belt tension; starting switch above. G—Motors and starting switches mounted on brackets on top of machines; now fed by temporary circuits but eventually through conduit.

size and type was advantageous under war conditions, for it reduced the spare equipment necessary, permitted rapid interchange in case of trouble, and enabled an extra starting outfit mounted on a portable platform to be utilized at once in case of local difficulty. Under the stress of war production there was little time to select motors of heterogeneous sizes; production at top speed was everything and energy consumption for a given service a secondary matter. Sixty-one of the motors were of the 25-hp. size and fifteen were 20-hp. outfits. As the work progressed, however, considerable attention was given to power requirements, and tests showed that as a rule a 25-hp. motor was loaded to about 22 hp. The exigencies of production necessitated numerous changes in motor location and in shafting utilization. It is safe to say that as an average every motor in the plant was moved from four to six times.

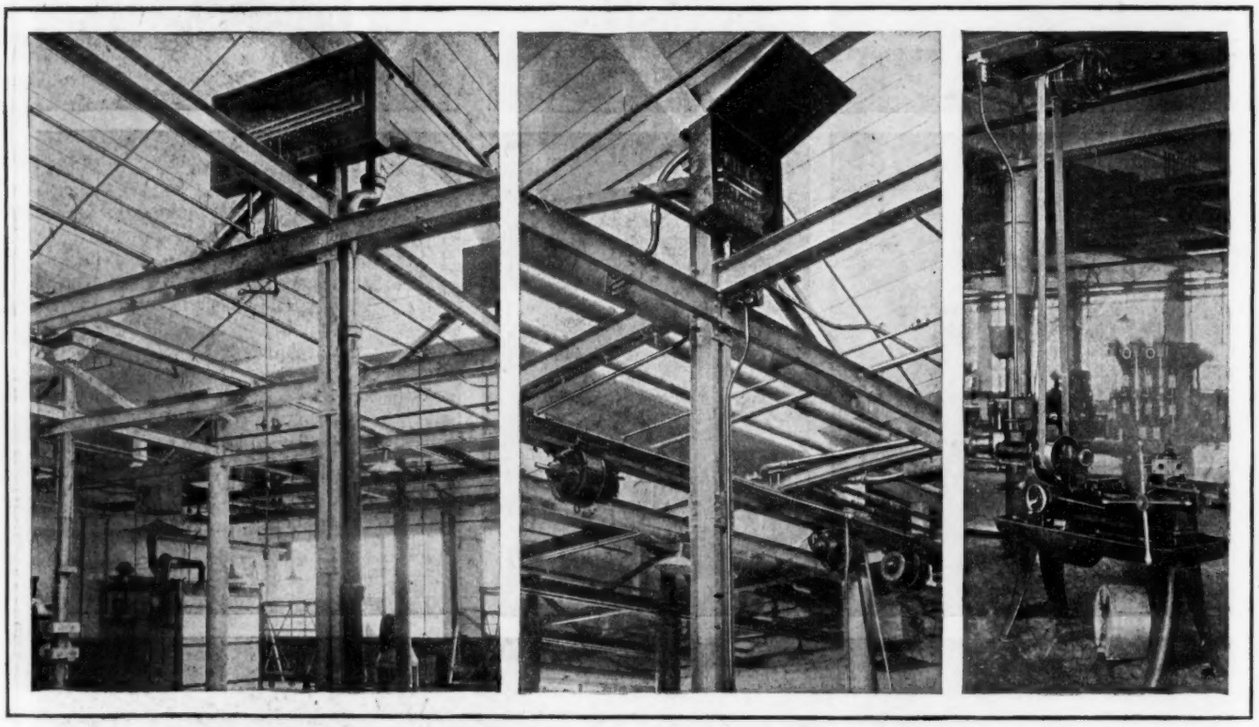


FIG. 3—METHODS OF MOUNTING POWER CABINETS AND SOME MOTOR DRIVES

Typical three-phase, 440-volt cabinet on channels feeds power load. The cabinet shown in middle photograph is for 230-volt direct-current distribution. Starter controlling motor overhead mounted on angles and straps and connected therewith by conduit.

The usual lighting arrangement was to install 100-watt gas-filled lamps in 14-in. (21-cm.) or 16-in. (24-cm.) Benjamin reflectors so as to utilize about 1 watt per square foot (11 watts per sq. m.) on the working plane. Drop lights were used where hollow or obstructed surfaces were to be worked upon and in some cases for bench work. The lighting service was 110 volts, single-phase.

ELECTRIC SERVICE FACILITIES

Energy is delivered to the plant by a 5500-volt, two-phase line running overhead in the form of a single circuit from the United company's hydroelectric station at Bircham Bend. Outside the factory two No. 2/0 duplex rubber-insulated, lead-covered cables are tapped into the line and feed the works as indicated in the single-line wiring diagram on page 625. Eight transformers aggregating 2000 kva. are installed in two independent substations near the center of distribution and about 80 ft. (24 m.) apart. Each substation contains four 250-kva. transformers set in two banks and delivering three-phase energy through Scott-connected windings at 440 volts to the secondary buses. Between the outside line and the transformers are a disconnecting oil switch and expulsion fuse in each leg of the incoming circuit to the primary windings. In each line from the transformer secondaries there is provided an 800-amp. single-throw oil switch with overload trip and time-limit relay. The substations are each provided with a three-phase bus installation, and the buses are provided with an interconnecting underground line for emergency service, with disconnecting knife and oil switches in each substation. Continuity of service is secured by this arrangement even should half the transformer equipment of the factory be out of commission. The cables between the transformer secondaries and the buses are of 1,300,000-circ. mil section, lead-covered and rubber-insulated.

The substations are similar in design in their alternating-current circuit arrangements, but in one a 150-kw. synchronous motor-generator set with appropriate switchboard facilities is provided to furnish direct current at 230 volts for such variable-speed motors as are required in the plant. This will later be increased by a duplicate set. Three-phase, 440-volt power feeders are run from the substation buses to cut-out boxes and power service cabinets on the various shop floors and bays, these cables being from 250,000 to 600,000 circ. mils in size in the feeds from one substation and 500,000 circ. mils in the other case. Each power feeder is controlled by an oil switch in the substation, and the cut-out boxes of course provide for the segregation of local distributing line groups as required. Two 300,000-circ. mil direct-current feeders are at present required for variable-speed motor work.

LIGHTING SERVICE

The lighting load is subdivided at each substation and fed by local transformer banks through three-phase circuits in each case. From one substation a No. 3/0 three-phase circuit is run to step-down transformers located on the roof of the building, the secondary mains feeding the local cabinets from this point. From the other substation, which furnishes the light-

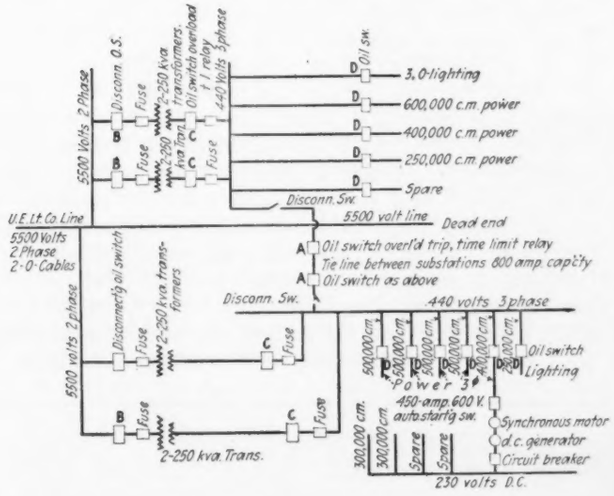


FIG. 4—GENERAL WIRING OF WESTINGHOUSE PLANT AT EAST SPRINGFIELD

ing service in the four-story building "A" near the entrance of the plant, a three-phase line of 25,000-circ. mil section is carried in conduit to two banks of transformers mounted outside the building at the second-floor level (Fig. 8). The feed to the primaries of each transformer, at 440 volts, is controlled by an oil switch inside the building. One bank is composed of three 37.5-kva. units, these feeding the second, third and fourth floors of the building respectively, through 500,000-circ. mil single-phase cables. The other bank, of

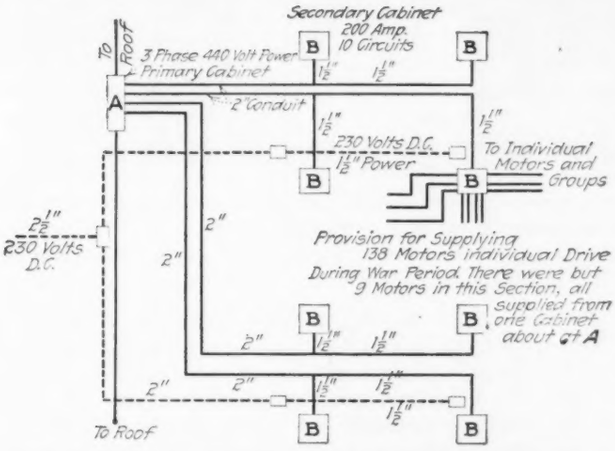

Secondary Cabinet
200 Amp.
10 Circuits
To Roof
3 Phase 440 Volt Power
Primary Cabinet
2" Conduit
230 Volts D.C.
To Individual Motors and Groups
Provision for Supplying 138 Motors Individual Drive During War Period. There were but 9 Motors in this Section, all supplied from one Cabinet about at A
To Roof

FIG. 5—WIRING OF SECTION OF SMALL MOTORS DEPARTMENT

20-kva. units, feeds the first floor, basement and the shipping building. The 110-volt service from the first bank is carried through the wall in conduit to a cut-out cabinet on each floor from which two single-phase mains are carried longitudinally through the plant, one feeding north and the other south, with a watchman's circuit in conduit serving a few lamps and separately controlled by a snap switch outside the main cabinet. The mains are of No. 2/0 copper and the guard light circuit is No. 14, six 100-watt units being used per floor.

The 37.5-kva. transformers are mounted on 9-in. (23-cm.) I- beams set in a concrete pit 6 in. (15 cm.) deep, the 20-kva. units being bolted to 10-in. (25-cm.) by 1½-in (3.8-cm.) channel irons bolted in turns through the building wall. As illustrated, the wiring layout of these banks is unusually compact and straightforward, with flexible control of the primary energy supply and convenient subdivision of the distribution circuit controls within the building at the different floor levels.

The adoption of individual motor drive for the plant necessitated considerable revision of the wiring layout in the various productive sections. The general scheme adopted is typified by the cabinet and conduit installation of a representative bay of building "F," outlined in the plan shown in Fig. 5. This bay is about 150 ft. (45 m.) long by 120 ft. (36 m.) wide and formerly contained woodworking machinery used in the production of rifle stocks. The equipment was driven by nine motors, all fed from a single cabinet, and was a rep-

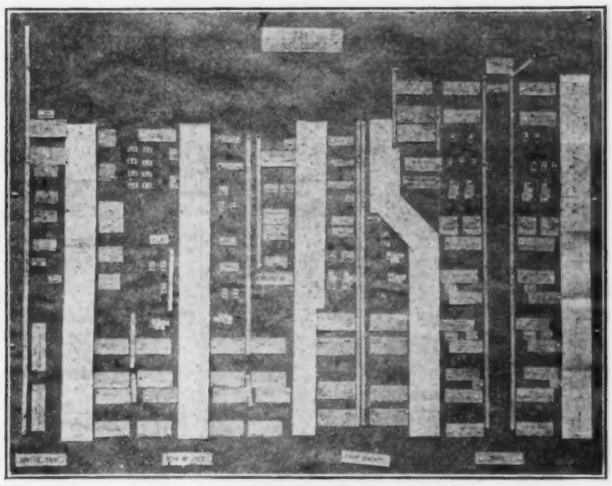


FIG. 6—PLAN OF A PRODUCTION SECTION USED TO LOCATE MOTORS

The broad white strips represent aisles and the narrow ones conveyors. Positions of operators are shown by dark-headed pins. The rectangular templets represent positions of machines.

resentative group-driven installation. Small-motor production takes the place of woodworking in this bay, and the ultimate installation provides for 138 machines, each independently driven. This change necessitated the provision of one primary and eight secondary cabinets for three-phase, 440-volt power service and four cabinets for 230-volt, two-wire direct-current power service. The primary cabinet is designed for ten circuits, two of which supply motor-driven blowers on the roof while the others are run to the secondary cabinets in 2-in. (5-cm.) conduit. The mains are No. 1/0 copper.

Each secondary cabinet feeds ten circuits or branches, each branch being designed to carry 30 amp. From one to three motors will be supplied per branch, according to tool requirements. The secondary cabinets are mounted on the columns and related bracings by 2-in. (5-cm.) channel irons. All feeds to cabinets and motors are run in conduit. Feeding from above was necessitated by absence of basements in the greater part of the factory. The direct-current motor service

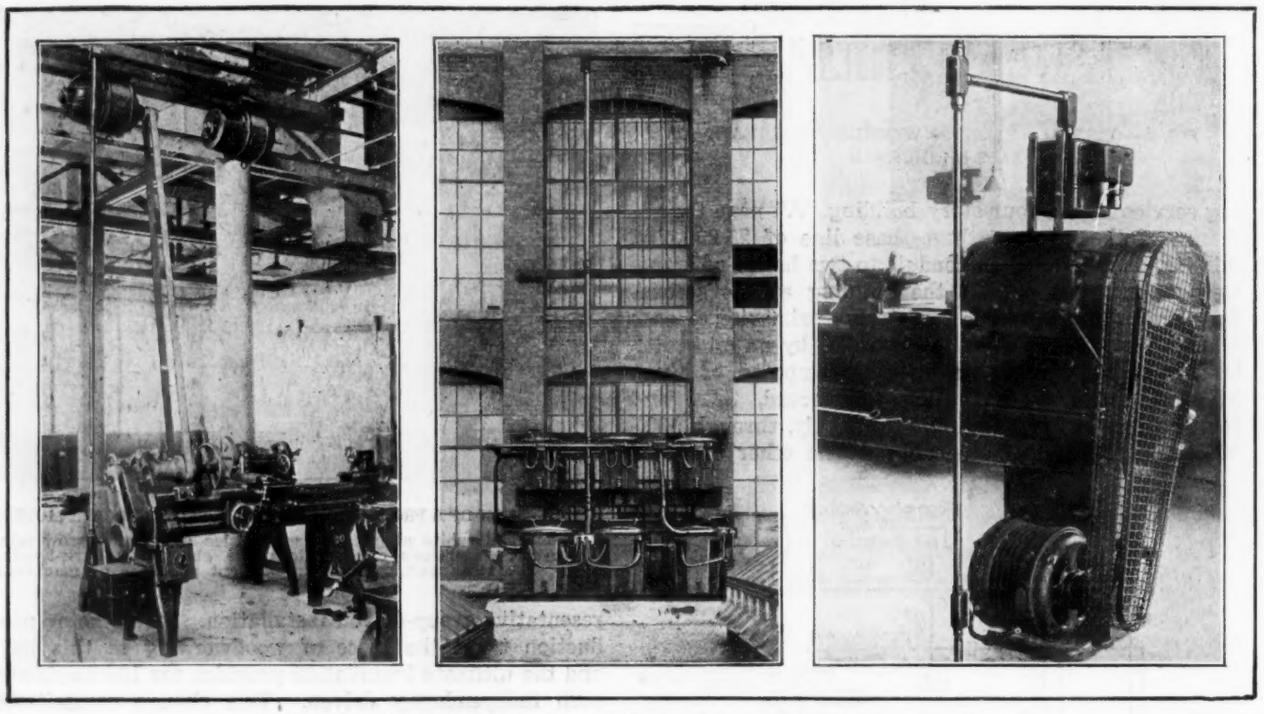
is supplied by six No. 1/0 circuits running from each typical cabinet to the motor group concerned. The cabinets are fed by 300,000-circ. mil direct-current mains running back to the substation busbars; these in turn are fed by the synchronous motor-generator set previously mentioned. Rubber-covered cable is carried through two bays of building "F" from a pothead outside, to serve the third bay, while the two bays above mentioned are fed from a wall cut-out box inside the building with runs of lead-covered cable which terminate at the direct-current cabinets controlling the branch circuits. In the new arrangement both direct-current and alternating-current cabinets are symmetrically disposed. The maximum distance between two adjacent alternating-current cabinets is about 38 ft. (11 m.) in one direction and 45 ft. (14 m.) in the other, the minimum distance being 27 ft. (8 m.). A 110-volt direct-current service for the energizing of magnetic chucks is also piped through this section of the factory.

In the equipment of the New England Westinghouse Company's war-time plant an elaborate lard-oil pumping system was in use. Under present conditions this equipment cannot be used to advantage in the reconstructed plant and is an example of valuable material which must be discarded or put to other uses elsewhere as a result of the transition from a war basis to a peace basis of production.

The new work of the plant requires the use of a number of coil-baking ovens, and two of the most advanced in design are illustrated. These embody a combined steam and electric heating installation, in which the latter is automatically regulated to maintain the desired temperature, while the major portion of the heat required is furnished at 120 lb. per square inch (8.4 kg.) by the steam supply. Each oven is equipped with twelve electric grids of 2.5 kw. rating each, installed four in series and fed from the 440-volt, three-phase supply. The electric service from each oven is started and stopped by push-button control (110-volt, single-phase service), and the grids are automatically cut in or out of service by contactors governed by a Tycos temperature-regulating device. Ventilation is provided by small motor-driven exhaust fans on top of the ovens. The ovens are of the Crawford sectional type and have Bristol recording thermometers.

In providing individual driving it was often difficult to find machine-tool equipment on the market which embodied the latest ideas in motor mounting, and it was therefore necessary in not a few cases to provide special brackets. In other instances the brackets have been cast integral with the machine-tool frames. The direct-current motors used are all equipped with push-button control and rheostats providing for speed variation. Where the machine tool had a sufficient speed change in its gearing or pulley arrangement alternating-current motors have been used. Conduit wiring has been employed throughout the factory, and this enables short runs of motor-feed wires to be secured, with compact arrangement and a rugged mechanical installation of wiring. Starting switches, most of which are the latest Westinghouse type 815, are used and wherever practicable are mounted on the machine tools in convenient reach of the operator. In some cases they are mounted in compact groups on a column, permitting the control of from one to four machines from a single point. Special pains has been taken to locate the motor control switches conveniently to the position of the machine operator. The use of push-button control and simple starting switches minimizes the probability of interruption due to careless operation. Details of the motor applications are illustrated.

A. B. Reynders is works manager and R. P. King is electrical engineer of the East Springfield factory.



FIGS. 7 TO 9—MOTOR DRIVES AND TRANSFORMERS SUPPLYING ONE SECTION

Two motors fed from one conduit and controlled by push-button under step cone pulley; method of mounting two banks of transformers; motor fed by conduit from control convenient to operator.

Unit Analyses of Industrial Power Business

Records of Massachusetts Central Stations Show that Desirable Revenue Is Consistent with Moderate Average Yield per Kilowatt-Hour—Motor Service Now as Important as Lighting Spuply Throughout the Year

JUDGING from the operating records of nine of the larger Massachusetts central stations, motor service has come into its own as a major source of revenue, and this at average returns per kilowatt-hour delivered to customers which leave little ground for criticism of rates. The development of power business during the last decade has become familiar to every progressive central-station worker as one of the most important factors in efficient plant operation and in the larger community service. The general advantages of maintaining a substantial power service need no discussion to-day. It was the very backbone of central-station war duty and bids fair to remain so important in the future supply of electricity to industry that a return to the period of decentralized operation seems economically unthinkable.

Just what the supply of power to industry means to the central station in a group of specific cases, however, forms a proper subject of inquiry. The last year of the war found the central station at the top notch of power production, compared with former times. As the electrical industry advances into the reconstruction period, it is significant to set forth the statistical phases of 1918 power business in these concrete instances, looking upon the data compiled as a base from which to make other comparisons in future. Certain similarities in data persist among the different companies, and it is of interest to apply the unit data and ratio computed in many other comparisons rendered desirable by the pressure of moderate costs. Although the industry has undergone various changes in load since the close of the war, the characteristics of the power business as it was being handled in 1918 before the armistice are of great present interest, and for this reason: Industry was electrified to win the war, and without this victory would have been impossible. Intensified production was the key to success in the supply of war material, and this imposed conditions upon the central station that displayed the power business at its maximum value. Long-hour service, often continuous throughout the twenty-four hours, raised the volume of energy required to totals never before attained. This meant the most favorable use of plant—a sort of high-water mark in output—and the diversity factor in motor service came to the front. What this means to future power service development is indicated by the figures which follow.

1918 Power Sales of Nine Massachusetts Companies

In the twelve months covered by the data presented the nine stations sold over 284,000,000 kw.-hr., of which about 181,400,000 kw.-hr. went to power users. Table I shows the power sales in energy and revenue for these companies, which combined had a connected motor load of about 121,000 kw., nearly 21,000 installed motors and a power revenue of nearly $3,500,000. More than 6000 power customers were on the books of these companies in the summer before the war gave place to the armistice. Table II, which gives the population served by these companies, the total energy output sold and other data of interest from the load viewpoint, shows that the nine companies, serving some of the most industrial and commercial communities of the state, sold altogether more than $8,000,000 worth of electricity in the year, with more than 1,000,000 persons living in their territories. By and large, 272 kw.-hr. were sold per capita on these systems for all electrical purposes, and of this 173 kw.-hr. went into power applications. It is interesting to note that the total connected load of these systems was about 234,000 kw. and the combined generating plant capacity was 184,950 kw., showing a diversity factor very much worth while. But is the diversity factor of industrial power business realized?

The Over-Motoring Epidemic

The total connected power load of the combined stations was 121,318 kw., but the average power load at the customers' installations was only 20,700 kw., computed on a twenty-four-hour basis. This, of course, takes no account of the fluctuations of the daily load curve from hour to hour, and so it gives no answer to the question of station capacity needed for a given volume of power business. Line and transformer losses are also not considered as a whole. But there is significance, none the less, in this tremendous discrepancy between the combined motor ratings and their average use throughout the year. Such a condition emphasizes the immense importance of studying motor installations to cut down needless excess capacity and of "going after" power business with might and main and doing a good deal less worrying about the ability of the plant and distribution system to absorb new loads. Close study of peak loads is of course essential, but in the present stage of central-station service it is assuming too much to equate motor name plates with subsequent loads to be carried over long average periods. Over-motoring has been suspected for some time by far-sighted central-station engineers, and this 5.86 to 1 ratio (Table VIII) between connected and average power load indicates that it is with us on an exceedingly large scale and must be attacked with vigor in the effort to secure the better power-factor conditions and lower investment costs which the reconstruction period insistently demands. Excess capacity was entirely excusable in the rush of electrifying munitions plants, but the time has come to fit motors far more closely to their tasks than was possible in the war period.

Industrial Loads of Massachusetts Cities

The tables show that a surprising variation in the use of electric power occurs between cities of fairly comparable size within the same small state. New Bedford heads the list as the largest seller of energy, both for general purposes and for power. This system has expanded to an extraordinary degree within the last few years, taking over some of the largest textile

mills in the state and supplying energy to an extended outside territory from a tidewater station designed for super-power supply. The large power output sold at Salem is due to a single textile mill supplied by the company, the mill operating more than 3200 motors, 2920 being in a single room. Worcester, a city of diversified manufactures and varied commercial activities, is the largest place covered in this analysis. Its

UNIT ANALYSES OF INDUSTRIAL POWER BUSINESS

TABLE I—POWER SALES IN ENERGY AND REVENUE FOR NINE MASSACHUSETTS CENTRAL STATION COMPANIES

	Power Sales in Kw.-Hr.	Connected Power Load in Kw.-Hr.	Power Sales	Number Motors	Number Power Customers
Worcester	32,147,134	20,966	$636,265	4,384	1,408
Salem	14,922,592	9,170	273,925	3,735	291
Fall River	21,691,318	14,833	365,586	1,425	351
Brockton	13,166,262	10,638	317,672	1,846	570
Lowell	15,788,068	10,854	322,789	1,975	588
Springfield	21,906,989	14,790	491,483	2,060	906
New Bedford	41,376,206	24,293	593,106	2,661	662
Cambridge	14,615,379	9,695	338,549	1,878	589
Lynn	5,847,568	6,079	155,417	991	655
Totals	181,461,416	121,318	$3,494,792	20,955	6,020

TABLE II—TOTAL ENERGY OUTPUT SOLD, STATION RATING AND CONNECTED LOAD AND POPULATION SERVED BY NINE MASSACHUSETTS CENTRAL STATION COMPANIES

	Total Kw.-Hr. Sold All Purposes	Total Revenue for Kw.-Hr. Sold	Station Rating in Kw.	Total Connected Load Kw. on System	Population Served
Worcester	51,419,947	$1,515,439	34,600	40,227	166,019
Salem	31,484,071	596,873.	17,000	16,090	37,200
Fall River	27,356,621	739,147	15,200.	23,571	133,988
Brockton	24,000,675	731,973	18,500	20,236	102,942
Lowell	23,058,757	732,899	9,550	22,810	129,503
Springfield	39,838,126	1,385,955	33,600	42,358	116,092
New Bedford	54,631,074	1,084,394	37,000	32,008	136,506
Cambridge	19,942,851	725,950	11,000	17,476	108,822
Lynn	12,269,677	661,550	8,500	18,413	114,761
Totals	284,001,799	$8,174,180	184,950	233,189	1,045,833

TABLE III—AVERAGE REVENUE AND AVERAGE CONNECTED LOAD DATA

	Average Power Revenue per Kw.-Hr. Sold, Cents	Average Revenue per Kw. Connected Motor Load	Average Connected Kw. Power Load per Power Customer	Average Connected Kw. per Motor	Average Number of Motors per Power Customer
Worcester	1.98	$30.40	14.9	4.77	3.1
Salem	1.83	29.80	31.6	2.46	12.8
Fall River	1.68	24.60	42.3	10.4	4.06
Brockton	2.41	29.80	18.7	5.77	3.23
Lowell	2.05	29.70	18.4	5.48	3.36
Springfield	2.24	33.30	16.3	7.17	2.27
New Bedford	1.43	24.40	36.7	9.12	4.03
Cambridge	2.32	35.00	16.5	5.16	3.19
Lynn	2.66	25.60	9.27	6.14	1.51

NOTE—Column 2 shows the average revenue per year per kilowatt of connected motor load.

TABLE IV—REVENUE PER TOTAL KILOWATT-HOURS SOLD AND PER KILOWATT OF CONNECTED LOAD

	Revenue per Total Kw.-hr Sold	Revenue per Total Kw. Connected Load
Worcester	2.95 cts.	$37.70
Salem	1.9	37.10
Fall River	2.7	31.40
Brockton	3.04	36.10
Lowell	3.18	32.10
Springfield	3.48	32.80
New Bedford	1.98	33.90
Cambridge	3.64	41.50
Lynn	5.4	35.90

TABLE V—DATA FOR MOTOR LOAD OF NINE MASSACHUSETTS COMPANIES, SHOWING TENDENCY TOWARD OVER MOTORING IN INDIVIDUAL PLANTS

	Average Combined Power Load in Kw. at Customer's Installation	Ratio Connected Power Load to Average Power Load	Ratio Connected Power Load to Total Connected Load, per Cent	Average Total Load in Kw. on System
Worcester	2,660	5.72	52	5,860
Salem	1,705	5.39	57	3,600
Fall River	2,480	5.98	63	3,120
Brockton	1,500	7.1	52 5	2,740
Lowell	1,800	6.03	47.6	2,630
Springfield	2,500	5.91	34.9	4,550
New Bedford	4,710	5.17	75.9	6,240
Cambridge	1,670	5.8	55.5	2,280
Lynn	665	9.15	33.0	1,400

TABLE VI—RATIOS OF POWER BUSINESS TO TOTAL SALES

	Ratio Kw.-Hr Power Sales to Kw.-Hr. Total Sales, per Cent	Ratio Power Sales to Total Sales
Worcester	62.6	42
Salem	47.5	45.8
Fall River	79.4	49.5
Brockton	54.8	43 3
Lowell	68.4	44.1
Springfield	55	35.5
New Bedford	80	49.7
Cambridge	73.3	46.6
Lynn	47.6	23.5

TABLE VII—POWER SALES PER CAPITA PER YEAR

	Kw.-Hr.	
Worcester	193	$3.83
Salem	402	7 36
Fall River	162	2.73
Brockton	128	3.09
Lowell	122	2.49
Springfield	189	4 23
New Bedford	303	4 35
Cambridge	134	3.11
Lynn	596	1.35

TABLE VIII—UNIT DATA AVERAGED FOR THE NINE CENTRAL STATIONS OF TABLE I

Average power revenue per kw.-hr. sold, cents	1 925
Average revenue per kw. connected motor load	$28 8'
Average connected kw. power load per power customer	40 2
Average connected kw. per motor (power load)	5 6
Average number of motors per power customer	3 5
Average revenue per total kw.-hr. sold, cents	2.8.
Average revenue per total kw. connected load	$35.10
Average power load in kw. combined installations	20.700
Ratio connected power load to average power load	5.86 to 1
Ratio connected power load to total connected load, per cent	52
Ratio kw.-hr. power sale to total sales, per cent	64
Ratio kw.-hr. power revenue to total revenue, per cent	42 5
Kw.-hr. power sales per capita	173 5
Power revenue per capita per year	$3.34
Average total load in kw. combined installations	32,400
Total revenue per capita per year	$7.80

power development has been forging rapidly ahead during the past few years, and it exhibits the largest number of motors of any of the central-station distribution systems tabluated, 4384. It should also be said that the total yearly sales of energy reflected at Worcester, Springfield and Salem in particular are favorably influenced by the interconnection to which the plants are parties, although not mutually related electrically. At the present stage of central-station development in Massachusetts it may be hazarded on the strength of these tabulations that a reasonable cultivation of the power field for a diversified manufacturing city of, say, 125,000 to 150,000 inhabitants means minimum annual power sales of 20,000,000 kw.-hr. to 25,000,000 kw.-hr., a connected motor load of 15,000 hp. to 20,000 hp. and power revenue of $400,000 to $500,000 a year. That such figures set the bounds for future development is not to be assumed for a moment. No reflection is intended upon any of the plants listed in these comparisons which may at present be running below this plane of power business. Local conditions to a large extent determine the possibilities in any particular year, but it is interesting to find in the tabulations given ample indication that for many cities the power saturation point is still a long way off—a most encouraging incentive to continued development with every resource available.

Small Cost of Electric Service

An impressive point in Tables I and II is the comparatively small cost of electric service to the communities supplied, and this in a time when the prices of commodities in general are on a plane unequaled in the memory of the present generation. Take the total cost of electric service in these nine cities, and it appears that in two-thirds of them it was less than $750,000 per year, covering domestic and commercial lighting, street and public building lighting, power and miscellaneous service, and in some cases electric railway supply on a small scale. Could there be a better example of the reasonableness of electric utility charges for power service itself, when one sees that in only two of the nine cities did the sale of power exceed $500,000 per year? The companies delivered energy for power in blocks which ran from a total of 10,000,000 kw.-hr. to 20,000,000 kw.-hr. in a year in four cases, over 20,000,000 kw.-hr. in four cases and below 10,000,000 kw.-hr. in only one.

Average Revenue per Kilowatt-Hour Sold

It follows that the average revenue per kilowatt-hour sold for power purposes was moderate. The individual companies sold power for the fiscal year 1918 at average rates per kilowatt-hour ranging from 1.43 cents to 2.66 cents, and this at a time when the cost of coal to these companies ranged from $6.76 to $12.76 per average ton burned during the year. The entire group of nine companies averaged 1.925 cents per kilowatt-hour of power sold. The average revenue per kilowatt of connected motor load per year was $28.80, or $21.50 per horsepower connected. Table III shows this detail for the several companies, with average connected load in power equipment per power customer, ranging from 9.27 kw. to 42.3 kw. The presence of large mills as single customers in cities where the loads are not greatly diversified makes it desirable to confine attention to systems independent of one or two large industries in studying the ratings of individual customers. Thus the average connected load per power customer for the entire nine systems was but 5.8 kw. power load. A better idea of the loading of the average customer can be obtained from cities like Worcester, Springfield and Cambridge, which have respectively in these data sheets 14.9, 16.3 and 16.5 kw. per power customer, connected load. The average rating per motor naturally varies widely with the class of power business predominating. At Worcester this is 4.77 kw. (6.4 hp.), at Springfield it is 7.17 kw. (9.6 hp.), and at Salem it is 2.46 kw. (3.3 hp.), the last due doubtless to the large use in weaving of motors below 1 hp. in rating. Three or four motors per customer of power service appears to be a general installation, outside the Salem and Lynn cases.

Average Revenue per Kilowatt Connected Load

Table IV shows the revenue per total kilowatt-hours sold and per kilowatt of connected load. This averages 2.88 cents for the nine companies in the former unit and $35.10 in the latter case. The increase above the power rates for lighting business is the chief explanation and needs little comment. It is surprising, however, that the average revenue per unit of total energy sold averaged so low, and aside from the influence of power business over long hours, that of long-hour illumination and especially industrial lighting during night shifts on war orders must not be overlooked. Table V illustrates the tendency toward over-motoring in individual installations, and it shows in a striking manner how important the power load has become. In two-thirds of these cities the connected motor load exceeds the total connected lighting load.

In the last column of this table one notes with surprise, perhaps, how moderate the average year-around demand may be upon the modern central station. Taking this into consideration with the station capacity, the incentive to work toward larger long-hour loads is clear. As in the study of motor ratings, these figures do not show what the plant capacity must be to handle the business, but they do point the way toward the cultivation of business which will tend to raise the station load factor and thus reduce unit operating costs and unit fixed charges at one and the same time.

The high ratios of power business to total as set forth in Table VI are evidences of the trend of the times in progressive central-station management.

Power Sales per Capita

Power sales per capita, detailed in Table VII, show substantial variations affected largely by the diversity of business handled. In the large textile cities the inhabitant gets the credit of a heavy annual use of electricity which generally belongs to his employer. Worcester, Springfield and Cambridge may again be cited in this connection as indices of distributed use of electricity for power among the population. For the entire group of plants Table VIII summarizes the foregoing data, and it is noteworthy that in the nine cities the average inhabitant pays $7.80 per year for his electrical service, $3.34 of which is for industrial power. The opportunities for future expansion of electrical service thus indicated are extremely attractive.

Experiences in Electric Steel Foundry

Data on Steel Furnace Performance—Results Obtained with Electric Core Baking—Features of Heat-Treating Installation—Executive's Intention to Increase Electrical Applications

SOME companies in every line of business never attempt anything new unless the method or procedure has been tried out by some one else and all obstacles have been removed for them. Then when they do get any additional information through their own efforts they hoard it instead of giving something to industry in return for what they gleaned from other companies' findings. This is true in many engineering lines, but the Connecticut Electric Steel Company, of which Edwin L. Willson is president, is one of the exceptions. This company believes in trying things out for itself and keeping no trade secrets. Steel is melted and refined by electricity exclusively in this plant, and while electricity is used for every other power or heating purpose that is usually found in a steel foundry, further applications are contemplated and will be developed and installed until this plant is all that its name implies.

Cost of electric energy is not the determining factor, because while electric melting may cost more than firing fuel, so far as energy is concerned, its advantages, which have been often reiterated in these columns, offset this greater energy cost. Mr. Willson is interested more in his entire plant cost per unit of product. If electric furnaces will give a better product than fuel-fired furnaces, permit ready duplication of results, simplify the labor problem, and require less skilled attention, they are the thing to use, in his opinion. These are the reasons why he is using and has been using electric furnaces for over two years. Very similar reasons are

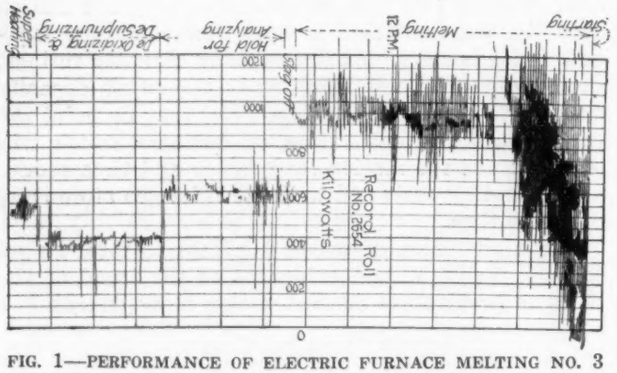


FIG. 1—PERFORMANCE OF ELECTRIC FURNACE MELTING NO. 3 ORDNANCE STEEL

given by him for using electric core-baking ovens, electric heat-treating furnaces, etc. The fact that his plant regularly turned out No. 3 ordnance steel for the United States Army with better than required characteristics and without any rejections on account of chemical analysis is silent testimony to the satisfaction the Connecticut Electric Steel Company has had with electric furnaces.

This plant has a connected load of about 2000 kw. and is a central-station customer, energy being obtained from the Hartford Electric Light Company at 11,000 volts and stepped down for light and power. Among the most interesting uses of electricity is its application to electric steel melting and refining, electric core baking and electric heat treating. The last application is just being made; the core-baking oven has been in service several months, and the electric furnaces, of which there are two 2-ton Heroult units, have been in service since the beginning of 1917. The company expects to replace gradually the oil-fired annealing furnaces now in use by electric ovens as investigation shows the best way to proceed. Of course, electric light and electricity for power purposes, to run cranes, grinders, etc., are used. Compressed air is used for portable grinders, as this method has given better satisfaction than electric grinders. However, the compressors furnishing the air are driven by motors.

PERFORMANCE OF STEEL FURNACES

The electric furnaces were both operated with basic linings until a short time ago, when one furnace was lined for the acid process. Tool steel and small steel castings are made, the principal output during the war being No. 3 ordnance steel, which has the following specified characteristics:

	Lb. per Sq.In.
Yield point or elastic limit	36,000
Tensile strength (ultimate)	80,000
	Per Cent
Elongation in 2 in	15
Contraction of area	20
Phosphorus (maximum)	0.05
Sulphur (maximum)	0.06

As an indication of how well the electric furnaces permitted meeting these specifications the following typical analysis may be cited::

	Lb. per Sq.In.
Yield point or elastic limit	50,900
Tensile strength (ultimate)	88,500
	Per Cent
Elongation in 2 in	25
Contraction of area	41
Carbon	0.437
Manganese	0.61
Silicon	0.37
Phosphorus	0.025
Sulphur	0.027

In making steel of the foregoing analysis the electrical conditions were similar to those shown by the accompanying load curve reproduced from the recording wattmeter on one of the furnaces. In starting with cold scrap the power input to the furnace is limited only by the contact of the electrodes with the charge and the reactance of the transformers (over 1200 kw. in the case shown with transformer having 12 per cent. reactance), the cold scrap having an enormous capacity for absorbing heat. During the early part of the melting period the fluctuations are severe, due to the frequent breaking of the arc because of the hunting of the electrodes and to short circuits due to scrap falling against an electrode after it has burrowed its way into a pile of metal and made a molten pool. Conditions become more stable as the melt proceeds, however, and after about twenty minutes the power fluctuations are less severe. In the case illustrated the

melting was completed in about one hour and ten minutes and the phosphorous slag drawn off, oxidizing conditions being maintained up to this point. Then the power input was held at about 600 kw. while analysis and correction of the steel were being made, which occupied about thirty minutes. With these operations completed the deoxidizing and desulphurizing process was started by maintaining a power input of 400 kw. for twenty-five minutes, under a reducing slag. Last of all came the superheating period, which lasted a little over five minutes.

A record of the amount of steel melted, number of heats made, average kilowatt-hours per gross ton of metal, average charging and melting time and pounds of electrodes consumed per gross ton of steel is given in the accompanying table for the last six months of 1918, when steel was being made for the United States Army. As may be noted, nearly 1,500,000 lb. of steel was melted and refined in this period, running on an average slightly over one heat per ten-hour day, which represents from one to four heats per working day from each furnace. "Slagging-off" raised the energy consumption per unit of product. The energy consumption per ton of steel was much less during the periods when three and four heats were made per day, because the heat stored up in the furnace, electrodes, etc., was distributed over more metal. Furthermore, the electrode consumption was less per unit of product because they were exposed to oxidizing conditions a relatively smaller portion of the time. The electrode

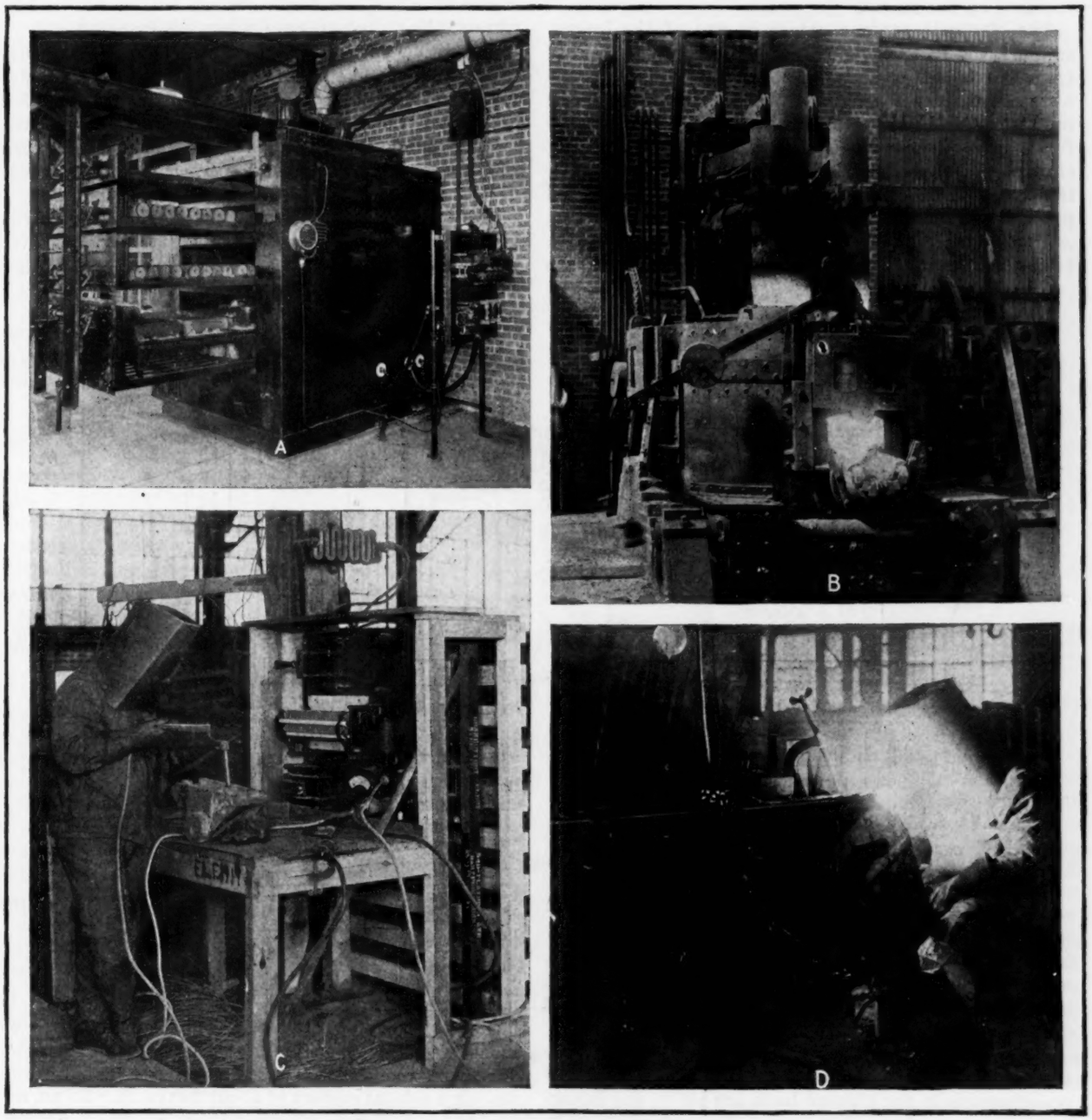


FIG. 2—SOME ELECTRICAL APPLICATIONS IN STEEL FOUNDRY

A—Core-baking oven with automatic temperature regulation. B—2-ton Heroult furnace. C—Carbon-arc welding. D—Saving casting by welding on new corner.

consumption was abnormally high, owing to the poor quality of electrodes obtainable during the war, resulting in excessive breakage, all of which is charged against the melting cost.

To indicate the effect of a second heat, or rather that of starting hot, on the energy consumption it might be pointed out that to melt and refine some forty-five-second hot light-casting steel 910 kw.-hr. per gross ton was required on the first heat whereas only 735 kw.-hr. was required on the second.

The electrode expense, which is one of the largest single items in the production of steel, may be gaged from the fact that about 66 lb. (30 kg.) of electrode were consumed per gross ton of steel melted under the conditions that existed during the war. The average for the first six months of 1919, using better quality electrodes, but under less favorable operating conditions, was 40 lb. (18 kg.) per ton. As is quite general practice, the electrodes are purchased in sections that can be joined together, so stubs can be easily utilized. Labor, refractories, energy and overhead constitute the remainder of electric steel-melting expense. As to refractory expense, it may be pointed out that about thirty to forty heats can be made with these electric furnaces, melting superheated casting steel, before a roof has to be relined. More heats can be made before replacement is necessary when melting tool steel.

To prevent excessive wear and tear on the electrode-feeding motors, the relays connected with the current transformers in the furnace leads are set so the motors will not be operating all the time. The retarding dashpots are set to allow a variation of 250 amp. above or below the normal setting before the electrode motors raise or lower the electrodes to decrease or increase the current in the arcs. No trouble has been experienced with the motors since they have been installed. In fact, they are given practically no attention, the bearings requiring no lubrication. The electrode holders as well as the collars in the roof of each furnace are water-cooled, a flow indicator being connected with each. Push-button control supplements the automatic control of the electrodes. When using the non-automatic control the connections are such that the electrodes can be raised faster than they are lowered. The reason for this is obvious, since it may be desired to withdraw the electrodes quickly. Direct-current energy for operating the furnace motors can be supplied by either of two motor generators—one rated at 10 kw. and the other at 5 kw. The former is capable of operating all the motors on both furnaces. If all of these precautions should ever fail, the electrodes can still be fed by hand wheels. No-voltage-release relays are installed.

Recording wattmeters are connected with each furnace to give records like the one illustrated, while ammeters are connected in each phase to permit balancing the heat and load on the central station. When automatic control is being used the current can be adjusted by changing the resistance in series with the relays on one furnace or by cutting out turns in the relays on the other.

Overheating of the furnace transformers is guarded against by having the attendants watch an indicating thermometer near the furnace and by a Tycos contact-making thermometer which trips the oil switch if a certain definite temperature is exceeded.

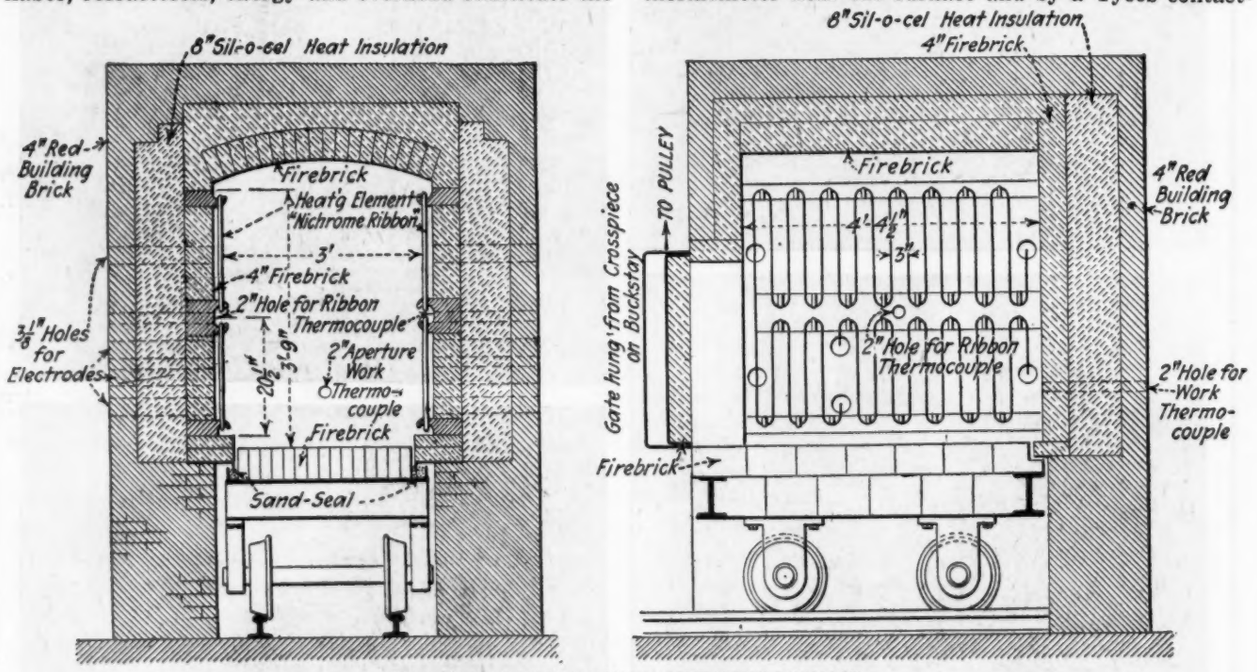


FIG. 3—FEATURES OF NEW ANNEALING FURNACE

ELECTRIC CORE BAKING

The core-baking oven which is installed is of the Young type, equipped with General Electric heating elements and control apparatus and a Tycos contact-making thermometer. It is merely a heat-insulated cabinet having a cubical content of about 200 cu. ft. (5.7 cu. m.), heated by Nichrome ribbon. These ribbons are wound on insulators at the bottom of the oven and connected with a 220-volt, three-phase circuit. Heat insulation in the form of "Sil-o-Cel" is used. The oven is rated at 30 kw. Under present conditions the contact-making thermometer is set to maintain a temperature between 425 deg. and 465 deg. C. On account of the reduced rate for using off-peak power the oven is usually operated at night. It is only necessary for the watchman to close the main switch at a certain time and open it at another definite time, the rest of the operation being

automatic. Standard operating conditions are thus reproduced in each bake, eliminating variations in the product and spoiled castings due to improperly baked cores.

Among the advantages of the outfit, as given by Mr. Willson, are the following: High heat efficiency, about 80 per cent, since there is very little opportunity for escape of heat except through radiators from the surfaces of the doors; no chance of cores overbaking because of automatic temperature control; a dry, non-contaminating heat owing to absence of combustion fumes, dust and soot; accuracy of control, assuring high quality of product; and minimum attention required because of automatic control and there being no ashes or fuel to cart. No data on the cost of operation have been collected, although some tests to determine the energy consumption per pound of cores baked are contemplated. The results will be presented in the ELECTRICAL WORLD.

HEAT TREATING BY ELECTRICITY

To heat-treat or anneal castings and tool steel that must be turned out in a shorter time than is permitted with the oil-fired heat-treating furnaces a furnace of new design is being erected. It was developed and is to be equipped by the General Electric Company, although the erection is being performed by the Connecticut Electric Steel Company. It is constructed to accommodate 1500 lb. of castings and has a cubical content of over 80 cu.ft. (2.2 cu.m.) directly under the arch. A general idea of its construction is given by the accompanying drawing.

The interior of the furnace measures about 4¼ ft. (1.3 m.) long by 3¾ ft. (1.14 m.) wide by 3 ft. (0.9 m.) high under the arch and is lined with firebrick. Supports for the heating element, which will consist of ½-in. by $\frac{1}{16}$-in. (12.7-mm. by 1.6-mm.) Nichrome ribbon, are of special composition blocks laid in the wall when "bricking up." Two tiers of ribbon, hung in waves, are provided on each side and connected to terminals passing through special composition bushing to the exterior of the furnace, where the groups of ribbons are connected in star to a 220-volt, three-phase circuit. The furnace hearth is the car type with "Sil-o-Cel" insulation and firebrick deck. A sand seal is used between the edges of the truck and the furnace walls to prevent escape of heat and entrance of air.

Between the outer red-brick wall and the firebrick lining is an 8-in. (20-cm.) section of "Sil-o-Cel" heat insulation. One 2-in. aperture is provided at the back of the furnace for the work thermocouple and another through the side wall and a ribbon support for the ribbon thermocouple. These are to be connected with indicating and recording instruments and a Leeds-Northrup potentiometer temperature control. The recording thermometer, which will register both the work and ribbon temperatures, will be watched by the furnace attendant until the two lines become parallel, which indicates that the work has reached its maximum temperature and can absorb no more heat. The temperature will be maintained between 850 deg. and 875 deg. C. automatically, so little attention will be required except to note when to withdraw the charge.

It is expected that two heats can be run per ten-hour day, whereas only one can be run with the larger oil-fired heat-treating furnaces. Burning of the arch will not be experienced, owing to the absence of oxidizing flames and no portion of the furnace being at a higher temperature than 900 deg. C. Oxidation of the charge will be practically eliminated, so there will be very little scale to remove, if any. Uniform heating of the charge will be secured because of small mass and relatively low temperature of heating element. Accurate control and minimizing of attention will be other advantages.

ELECTRIC WELDING SAVES $28,000

A Wilson electric welding outfit is installed with two welding stations which has been of immense value to the company. During the war cracks occurred in some of the gun foundations where the pouring gates joined the castings which would have necessitated scrapping the castings had it not been for electric welding. Upon approval of the Ordnance Department authorities the company was allowed to remove the corner of each casting and fill with welded metal. After annealing, machining and polishing with emery it was impossible to notice where the weld left off and the parent metal began. For preparing the parent metal carbon electrodes ½ in. (1.25 cm.) in diameter were used with a current of 200 amp. to 250 amp. To deposit the metal, however, uncoated metallic electrodes were employed, having similar chemical characteristics to the parent metal. With these a current of 130 amp. was employed. Constant energy at the arc is maintained automatically by a solenoid-operated carbon-pile resistance, when welding with the metallic electrode. When using the carbon the automatic regulator is disconnected and a reactor and resistor substituted in the welding circuit by throwing a double-throw switch. With this system an inexperienced operator is able to maintain a current constant within 1 per cent. after a few minutes' practice. Compared with acetylene welding, the electric process gives more uniform results at a considerable saving in cost.

PERFORMANCE OF TWO 2-TON HEROULT FURNACES*
(Melting and refining ordnance No. 3 steel during 1918)

Furnace	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 1. Steel melted (lb.)	103,923	.....	109,895	199,430	91,097	50,560
No. 2. Steel melted (lb.)	82,043	167,300	91,975	52,089	150,712	246,492
No. 1. Heats made	25	0	27	49	23	13
No. 2. Heats made	20	45	25	13	37	61
No. 1. Average kw.-hr. (tons gross)	1,060	0	710	635	705	1,370
No. 2. Average kw.-hr. (tons gross)	1,290	1,040	1,160	1,610	1,125	785
No. 1. Average charging time (min.)	38	0	30	28	25	27
No. 2. Average charging time (min.)	35	29	29	30	27	20
No. 1. Average melting time (hr.-min.)	4–0	0	3–24	3–15	3–24	3–36
No. 2. Average melting time (hr.-min.)	3–53	3–18	3–12	2–55	3–0	2–49
No. 1. Average heats per 10-hr. day	1.02	0	1.22	1.96	1.04	0.55
No. 2. Average heats per 10-hr. day	0.85	1.82	1.14	0.52	1.66	2.60
No. 1. Lb. electrode, 1 ton steel	39.4	0	59.6	51.5	35.5	113
No. 2. Lb. electrode, 1 ton steel	85.0	54	44.5	96	98.0	54

* Voltage between phases at furnace electrodes 100 volts; tonnage and pounds in gross weight. Furnace No. 1, transformers rated at 600 kva., consisting of three single-phase, self-cooled units of 200 kva. each, connected delta-delta. Furnace No. 2, one three-phase transformer, 800 kva., water-cooled, connected delta-delta. The higher power on No. 2 accounts for faster melting.

MOTOR TROUBLES FEW AND DISAPPEARING

Very few motor troubles are experienced considering the severity of the service. Emery and steel dust did cause trouble with the sleeve-bearing motors used on

the swinging-frame grinders. This trouble has to be combated by shielding the motors from the stream of particles flying off the emery wheels, by drawing off the oil in the bearings once a month and by placing a perforated cone containing waste in the oiling apertures. In addition, the motors are blown out with compressed air once a week. Ever since Fairbanks-Morse motors with S.K.F. ball bearings were placed on some of the grinders the troubles formerly experienced have practically ceased, so the sleeve-bearing motors still remaining will eventually be transferred to some other part of the plant where there is less abrasive dust.

Slip-ring induction motors are used on all cranes, and the speed control has been found sufficiently delicate to permit drawing large patterns from the sand.

In the part of the plant where castings are inspected Cooper Hewitt lamps are installed, as Mr. Willson says the "monochromatic" light furnished by these units facilitates the detection of flaws.

When the plant was first started numerous spare parts for the electric furnace were purchased, but to date practically the only replacements necessary have been a contactor coil and two contacts, so the electrical maintenance is inconsequential.

DISTINCTIVE MARKING OF ELECTRICAL APPARATUS

Necessary to Provide Safety for Electricians and Workers and Facilitates Maintenance and Repair Work

BY F. BECHOFF

MARKING and labeling electrical apparatus as a means for identifying circuits and equipment supplied through them becomes especially important in large industrial installations like chemical plants or steel mills. A far greater variety of equipment distributed over a larger area is present in an industrial plant than is the case in central stations, power houses and substations. Furthermore, it is difficult to obtain such efficient and well-trained operators and helpers in industrial plants as are found in central stations. The distinctive marking is thus not only valuable from a safety standpoint but is of great value for the construction and maintenance department, because it facilitates repairs and eliminates errors.

The distinctive marking of equipment should be as far as possible uniform throughout the entire plant. This can be partly accomplished by strictly adhering to the following regulations:

All generators, motors, power transformers, lightning arresters, isolated oil and disconnecting switches, control and starting apparatus, emergency switches, plug outlets, end bells, concealed boxes, brick or concrete compartments containing electrical apparatus or other inclosures of such equipment should be marked with a distinctive sign giving in general the designation and circuit number of the apparatus. The exact wording of the sign should be copied preferably from the electrical drawings, such as wiring diagrams or other switchboard drawings, which enumerate all the circuits in the plant. It is further desirable that the selected sign should be painted in a conspicuous place on the surface of the apparatus. All letters and figures should be solid black on a white background and preferably about 1½ in. (3.7 cm.) high, with exception of signs for very large apparatus, where considerably larger lettering should be used. The inscription should be surrounded with a black border ¼ in. (6 mm.) wide, and the border should be ⅜ in. (9.5 mm.) outside all lettering and figures.

Identical lettering should be adopted for all signs applied to apparatus pertaining to one common circuit. For instance, a motor, an oil circuit breaker, a disconnecting switch, a switch cell controller and an end bell in circuit for condenser pump No. 3 should all be marked "Condenser Pump No. 3." The distinctive sign should be painted when possible directly on the frame of generators, motors, power transformers and similar apparatus and on a separate panel when necessary. The marking of switch structures, cells and busbar compartments should be placed directly on the exposed surfaces. It is preferable to mark both the front and rear walls of the compartment at a suitable height from the floor, preferably at a height of about 4 ft. (1.2 m.)

For compartments with hinged doors the distinctive sign should be painted on the outside of the door at the same height as the structure itself, and it is important that all signs line up throughout the structure. In all cases, however, where there are provided removable or rolling doors a supplementary identical marking should be provided. The latter can be applied either to the supporting steelwork or to the compartment wall. This precaution insures the return of the removed doors to their proper stations after repairs or inspections have been completed.

Disconnecting switches which are mounted above or below a switch cell but on the same floor do not require a separate marking since the sign at the front or rear of the respective cell is considered sufficient.

Disconnecting switches mounted separately—as, for instance, on another floor or in such other location that their purposes are subject to question—must be provided with a distinctive sign which can be painted either on the supporting framework or on a separate wooden panel mounted below the switch in a convenient place. If barriers are present separating the different phases, the phase number or letter should be added to the sign or painted on the side of the barrier.

The same rules apply to current and potential transformers. All busbars mounted in compartments or on framework should be marked at designated points with the phase figures 1, 2, 3 or letters A, B, C for alternating-current buses, + and — for direct-current buses. The marking of the buses must be in accordance with the electrical drawings.

For power circuits on transmission towers or poles the distinctive marking should be applied to the steel cross-arms. Such markings are especially required at all crossings and on lines of different voltages supported by a common tower. In such cases the voltage must be added to the sign. The towers and poles should also be marked with a distinguishing number and the date of erection.

All conduits when installed are identified by the conduit number or number and letter punched on one side of the conduit tag. The other side may be used to punch markings naming the use or purpose of the cables.

Danger and warning signs should be displayed in conspicuous places at all unattended and unlocked entrances to switch structures, bus structures, cable vaults, outdoor substations and all rooms and inclosures containing exposed current-carrying parts or moving parts.

INDUSTRIAL VIEWPOINT ON STANDARDIZATION

Experience of the Engineer Who Is the User of Electrical Equipment Emphasizes the Economies That Come from Fixing Standards

BY E. E. GEORGE
Electrical Engineer, Chicago, Ill.

STANDARDIZATION in its broad sense is a problem to be solved by education—not of the engineers, but of the buyers and sellers. Most of the opposition to standardization in any form is due to a fear that the exercise of judgment and the resulting exhibition of preference for a particular type will be detrimental to the development of the art. A study of past attempts at standardization shows no basis for such a fear. In 80 per cent of the cases the selection has stood the test of time. In the other 20 per cent the artificially hastened test of the type has shown its defects and has caused a speedy reversion to its competitors. The selection of a type and its attempted adaptation to all possible conditions of service merely accelerates its testing period. If the test is successful, as is usual, development work is speeded up. While it is perhaps too much to expect the entire industry to reach an early agreement on standardization of equipment, there is no logical reason why each industrial electrical engineer should not standardize on equipment for his own plant. Such practice will make for economy.

METHODS OF STANDARDIZATION

Equipment for industrial plants should be standardized as to size, type, quality, make and source. The selection of the source is generally a matter for the purchasing agent to handle. He is familiar with retailers, jobbers, salesmen, etc. The establishment of standard sizes is usually a matter of compromise between what the engineer needs and what the manufacturer can supply from his standard line. As the type and quality designations are often insufficient to secure the proper grade of material, it is usually necessary for the engineer to specify the maker. It may safely be said that on one-half of the machinery, tools, hardware, mill supplies and electrical goods on the market to-day the only sure method of getting the highest grade of goods is to specify the maker. High quality usually cannot be analyzed and put into "foolproof" specifications. It was once thought that the engineer or architect who specified a trade name or make was a grafter and was getting a "rake-off" for boosting the article in question. To-day the enginer is recognized as the logical man to make such a selection, instead of leaving it to a system of purchasing that was designed to eliminate the personal element.

As to the quality to be taken as a standard, it is the opinion of the writer that the best isn't good enough. This is particularly true of wiring devices which were developed to meet competitive bids on cut-rate house wiring. Every industrial electrical engineer who has had proper support from the management has developed improvements in the ordinary equipment and methods of interior wiring, generally in self-defence, to make the factory safe for the electricians.

Rosettes, metal sockets, cut-outs, lamp guards, switches, push-buttons, bells, annunciators, plug receptacles, lamp cord, solder and tape are often "built to a price." These items, although a small part of the electrical investment, constitute a large part of the trouble in the ordinary plant. Generators, circuit breakers, meters, transformers, power cables, conduit and the other expensive items developed especially for power work are almost "foolproof."

Intermediate between these two classes are motors, starters, insulated wire, fuses, lamps and insulators. Any one of the many good grades of these items is satisfactory for ordinary industrial service. It is in the first and last groups of materials especially that the engineer can save by standardization.

MAKING THE CHOICE OF GENERAL TYPES

As the most serviceable, simple, safe and economical standard layout for a small or moderate-sized plant the author would suggest the following: Purchase 60-cycle alternating current from a central station, step down from the standard primary voltage to 440 volts to feed a three-phase, three-wire distribution system with the real or artificial neutral grounded through a low resistance and a detector. Use a synchronous motor-generator set to supply a two-wire, 115-volt direct-current distribution system to feed all lamps, batteries, control equipment, signal systems, cranes, planers and variable-speed equipment. All constant-speed motors under 100 hp. should be of the squirrel-cage type, and those over 100 hp. should be synchronous. Primary voltage is preferable for the motor-generator set and all other synchronous motors. High-speed motors should be used wherever possible, as they are much cheaper, lighter, smaller and more efficient. Silent chain-drive or ball-bearing line shafts, or both, will permit high motor speeds. The modern tendency is to have as few adjustable-speed motors as possible and to use direct current for them. The modern change-gear box is often made with a speed range of twenty-five to one, while the best range with an adjustable speed motor is six to one. The fine variations possible with variable-speed controllers are seldom utilized, the 1.26 ratio of a change-gear device being standard for metal working. Where fine variation is essential, a field rheostat with 25 per cent variation, used in connection with a standard shunt motor and a 1.26 ratio gear-change box, will be satisfactory, except for remote control.

All motor controllers not operated exclusively by electricians should provide automatic acceleration and reversal, by push-button or drum-master switch control. Double-pole circuit breakers should be used on each motor in metal-working shops, with instantaneous trips and in some cases dynamic braking control. Above 100 amp., fuses are too slow in case of short circuits, grounds, flashing commutators, controllers stuck in the "on" position, etc. Circuit breakers will prevent broken tools, stripped gears, overloading of cranes, and destruction of equipment and personal injury from arcing.

The sizes of lamps should be reduced to a minimum; 15, 40, 100, 200, 500 and 1000-watt sizes are sufficient. Three types of reflectors in each of these sizes should meet all industrial requirements.

The general types of switchboards should be limited to primary four-wire, three-phase; to three-wire, three-phase, 440 volts, and to two-wire, direct-current, 110 volts, if possible. In primary switching most boards have too many "disconnects" and not enough oil circuit breakers. Except in the larger power stations, where a load dispatcher is on duty and where repair operations

are scheduled and checked as carefully as train dispatching by block signals and interlocks, a disconnecting switch is the most dangerous device frequently handled by electricians. The type which is shunted by a "Pyrene" fuse should replace all present installations, in the author's opinion.

ADVANTAGES OF STANDARDIZATION

Principal among the advantages that come from following a plan of standardization such as this are: (1) An accumulation of supplies and spare units available for quickly repairing or replacing inoperative equipment is possible along with a reduction in the total investment in such supplies and spares. (2) Larger purchases of each item, giving lower prices, better deliveries and decreased transportation charges. (3) Assurance of correct purchase orders is gained as the data on types and sizes can cheaply be recorded for reference. (4) A reduction in the cost of making and keeping a correct inventory of equipment will be possible. (5) Ease of locating trouble, as the maintenance departments quickly become familiar with the merits and defects of one manufacturer's equipment, is another advantage. (6) The greatest advantage, however, in the experience of the writer, lies in the efficient commercial relations, prompt delivery, reasonable price and accurate engineering advice given by every manufacturer, jobber or retailer to every customer who buys from him exclusively and in large quantities and who, in consequence, is an earnest and effective booster for the article in question.

The day of the purchasing agent who lets competitive bids for every purchase is past. Competitive bids are useful in determining standards, provided that the value of each article submitted in answer is as apparent to the purchasing agent as its price and delivery. After a standard of size, type, quality, make and source is determined upon there is no reason for competitive bidding. If the engineer has found "Paragon" brand to be the best for his purposes, it is studied inefficiency to insist upon his specifying "Paragon or equal" when he wants "Paragon" and when he cannot be convinced that it has an equal.

In determining standards the purchasing agent's knowledge of reputable efficient dealers, shipping routes, credits and quantity discounts should be as valuable as the engineer's knowledge of his requirements and the merits of different brands. These two men must cooperate to achieve permanently satisfactory standards. After standards have been established the purchasing work is largely a matter of quantity, shipping, credit and contracts. This may seem too much llike routine for some purchasing agents, but what could be more like routine than the antique practice of mailing inquiries to the three most prominent names in Hendrick's or McRae's Register, comparing prices and delivery, and then sending out the order? Such purchasing agents were high-priced office boys. The government's usual competitive bid basis of purchasing and selling is a relic of twenty years ago, when a sales corporation had no fixed prices but varied the price with each customer and with each order, and when the purchasing agent was supposed to have neither good judgment nor common honesty. Equipment should be selected with the same hope for permanency that one has when selecting medical, legal or financial service. One doesn't ask for competitive bids on medical attention every time he gets sick, and most industrial maintenance is just as urgent to financial welfare as medical attention is to physical prosperity.

The writer has had an opportunity to observe some of the results of electrical standardization during six years' connection with industrial plants both in the United States and in Canada. One metal-working plant, using about 125 motors, had nine makes of motors and the following sizes: 1 hp., 1¼ hp., 1½ hp., 1¾ hp., 2 hp., 2½ hp., 3 hp., 4 hp., 5 hp., 6 hp., 7 hp., 7½ hp., 10 hp., 12½ hp., 13 hp., 15 hp., 20 hp., 25 hp., 30 hp., 35 hp., 40 hp., 45 hp., 50 hp., 60 hp., 75 hp. and 85 hp. A stock of spare parts was out of the question. Later a standard for future purchases was established, using two makes, and the following ratings: 1 hp., 2 hp., 3 hp., 5 hp., 7½ hp., 10 hp., 15 hp., 20 hp., 35 hp., 50 hp., 75 hp. and 100 hp. These motors were all to be preferably of 850 r.p.m. One of the chief obstacles to the use of 850-r.p.m. motors was low-speed line shafts. Although 200 r.p.m. was considered a risky speed for ring oiling bearings—usually out of line 0.5 in. in 10 ft. (1.2 cm. in 3 m.)—800 r.p.m. was successful with self-adjusting ball-bearing shaft hangers and 450 r.p.m. was standardized for line-shaft speeds. This eliminated jack shafts and permitted high-speed motors with reasonable belt tensions. The spare-part problem then solved itself. It was found cheaper to carry complete motors in stock than to carry a complete stock of repair parts. It was usual practice to carry one motor of each of the larger sizes and one or two of the smaller sizes. In addition to this brushes for all motors and spare parts for starting boxes were carried in stock.

A large chemical plant with which the writer is familiar adopted a similar practice. It had installed about 40,000 hp. of motors, which were all of one make. It kept a few spares of each rating in stock. This was found to be a satisfactory plan because it is much quicker to replace a complete motor or starter in case of trouble than it is to attempt repairs on the spot.

Interesting as are all experiences in standardization, they are less important than at first might seem. The important thing is to find some method by means of which a start can be made toward standardization so that some of its results will be shown to those in responsible charge. Very little opposition will be encountered beyond that point from the management of the plant. In almost no case will opposition be encountered among the employees. In fact, one of the chief reasons why standardization is universally successful in reducing costs is that it inspires coöperation instead of opposition from labor, skilled or unskilled. It gratifies the restrained wish of every practical man to subordinate custom and red tape to common sense.

RESEARCH leads to discovery, discovery to invention, invention to no one knows where. Applied and supervised by those prepared for the task, the strides of progress will be long and the benefits in proportion. Let us educate for living, certainly, but let us also educate for leadership—that superlative leadership of which civilization will stand more and more in need as it increases in complexity and reaches higher and higher planes. *—Dr. William H. Nichols, president American Chemical Society.*

Converting Machines to Individual Drive

Manner in Which Motors and Control Were Made an Integral Part of Old Belt-Drive Machines by an Industrial-Plant Manager Who Abandoned Isolated Plant and Installed Central-Station Service

MANY industrial plants that are operating their equipment from steam engines with the attending disadvantages would like to substitute individual-drive motors and central-station service, but hesitate because they do not know how to adapt their existing machinery to the changed conditions without necessitating a large investment. The latter is not necessary, however, as was demonstrated by William H. Lockwood & Sons, electrotypers, Hartford, Conn., who were ingenious enough to work out a method whereby they adapted all their machines to individual drive without having to buy new machines. Conversion to group drive would have been simpler (one or several motors would have been belted to the existing line shafts), but the owner, William H. Lockwood, saw the greater advantages of individual drive.

The changes, which will be outlined in some detail, were made, the plant was converted to central-station service, and to-day Mr. Lockwood is as firm a believer in central-station service and individual drive as there is. He says that his firm has dispensed with shafting and hence with its limitations, that the shop does not have to depend on an isolated plant, which naturally had to be shut down occasionally for overhauling and emergency repairs, and that the central-station service is reliable and unfailing and ready for use any time of day or night.

In this connection it might be pointed out that formerly Mr. Lockwood purchased mechanical power from an adjacent plant and this was sometimes not available, owing to shutdowns for boiler cleaning. Furthermore, he was reticent about asking the adjacent plant to operate its power plant at night when he needed power for overtime work, although it did so on many occasions. Aside from the advantages thus indicated, the opportunity is now afforded to operate any one machine or several units without running shafting throughout the plant—a wasteful practice when friction losses, etc., are considered, even if the expense is not taken into account by some plant owners. With the individual drive now installed, in which each motor, with its corresponding starter, is an integral part of each machine, there is no obstruction to traffic, none of the unsightly belting or oil-dripping shaft hangers seen in some plants, and, besides, any machines can be unbolted from the floor and moved elsewhere, rebolted and started as soon as the wiring is reconnected.

Since the price which was formerly paid for mechanical power was lower than could be obtained anywhere else (owing to the relationship with the adjoining concern), comparison of present operating expenses with those formerly entailed would be of little value to any one. However, it may be said that the plant is now operating twenty-four motors, totaling 26½ hp., with a monthly energy consumption of only 1900 kw.-hr. This is based on an eight-and-a-half-hour workday and includes power used to drive motor-generator sets used in electrotyping. The average load on the two electroplating outfits is about 2 kw. The rating of each motor used, as well as the kind of machine driven, given in the table on page 640. The duty of each machine is not given because the work is like that of any electrotyping plant.

In order to keep the investment in motors at a minimum and to assure satisfactory operation of the units once they were installed, tests had to be made to determine the horsepower rating required for each machine. These tests were conducted by the power engineering department of the Hartford Electric Light Company by temporarily connecting a large motor onto the old line-shaft drive and taking wattmeter readings with all of the machines operating under normal conditions and then with each machine operating alone. Corrections were made for shaft friction, motor efficiency, etc. As a result of these tests the motor sizes indicated in the table referred to were chosen. It is interesting to note that some of these ratings are less than those recommended by the manufacturers of the electrotyping machinery, but this is evidently due to the fact that some manufacturers, in their desire to provide a margin of safety, provide too much and overmotor their machines. This statement does not apply in all cases, however, and power tests are recommended for each individual case.

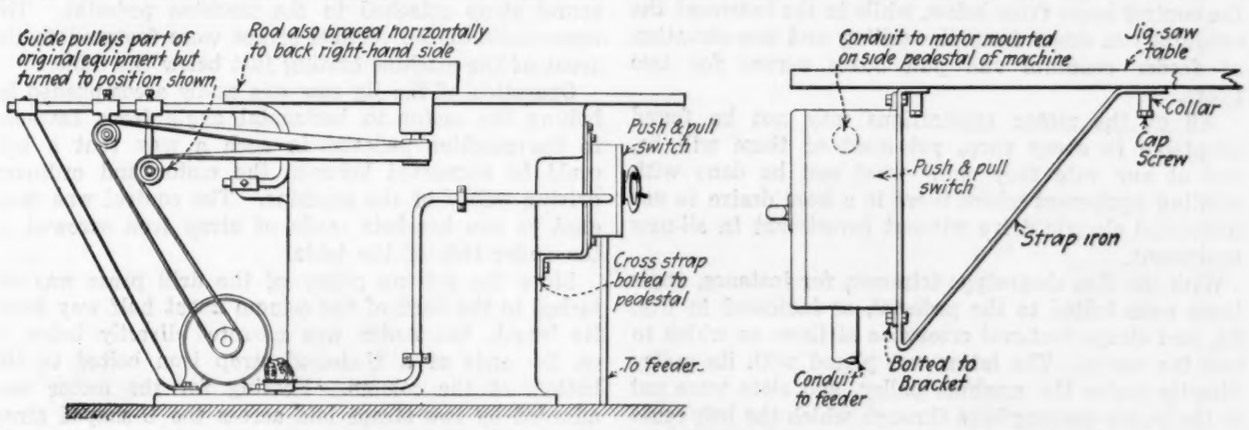

Guide pulleys part of original equipment but turned to position shown
Rod also braced horizontally to back right-hand side
Push & pull switch
Cross strap bolted to pedestal
To feeder
Conduit to motor mounted on side pedestal of machine
Jig-saw table
Collar
Cap Screw
Push & pull switch
Strap iron
Conduit to feeder
Bolted to Bracket

FIG. 1—BEVELING MACHINE DRIVE AND METHOD OF MOUNTING CONTROL BOX UNDER JIG-SAW TABLE

Motors with different speeds might have been used to simplify the speed reduction, but it was considered advisable in this case to use one make of motor (General Electric Type DSQ) and one speed (1800 r.p.m.) in order that the advantages of interchangeability and standardization could be realized. Furthermore, the high-speed motors were cheaper, more convenient to accommodate and the belt transmissions employed between them and the driven machines were about as simple as possible. Two-phase energy at a pressure of 220 volts is received from the central station.

Because of the relatively small size of the motors very few starting devices were needed, most of the motors being connected directly to the lines through inclosed four-pole push-and-pull fused switches, made by the Detroit Fuse & Manufacturing Company. In some cases, however, for instance, the molding presses, knife switches with starting and running positions were employed, and for the motor-generator sets starting compensators were used.

Adapting Old Machines to Individual Drive

Throughout the adaptation of the electrotyping machines to individual motor drive it was the aim to make the motors and starters integral parts of their respective machines, to place each motor where it would least interfere with shop operations and still be accessible for attention, and to mount the control where it would be within convenient reach of the operator. All the wiring to the control and between it and the corresponding motor is in conduit, and as stated before the live parts of the switches, except the double-throw switches with starting and running positions, are out of reach when operating the switch. Even the latter are inclosed in steel cabinets, however, so the entire installation presents no hazard.

Moving parts of the power-transmission mechanism which might constitute a hazard are boxed in or protected by screens in all cases. Metal shields are placed over each motor so that dust will not accumulate thereon, but in such a way as not to interfere with ventilation. On the main floor the service wires enter the control boxes from below, while in the basement the conduits run down from the ceiling and one elevation of feeder conduits and pull boxes serves for two floors.

All of the motor applications may not be found adaptable to every shop, yet most of them will be, and at any rate they show what can be done with existing equipment where there is a keen desire to use individual electric drive without investment in all-new equipment.

With the Hoe electrotype trimmer, for instance, angle irons were bolted to the pedestal, as indicated in Fig. 2A, and straps fastened crosswise of them on which to bolt the motor. The latter was placed with its pulley directly under the machine pulley, and slots were cut in the pulley bearing base through which the belt could run. For supporting the control box, which was of the push-and-pull type formerly mentioned, straps were bolted to the machine pedestal to which the lower part of the box was screwed. The upper part of the box was screwed to the front part of the machine between the table guides. Wiring between the motor and control box and between the latter and feeders was run in conduit as shown. This construction is quite typical of the entire installation.

Very little had to be done to the Wesel type-high planer because the motor could be bolted directly to the front of the machine pedestal, as shown, and belted to the machine pulley ordinarily driven from a line shaft. Because of the torque required to start the machine and the short distance between driving and driven pulley, it was considered advisable to attach an idler pulley to the side of the machine to increase the belt contact. The control is also bolted direct to the machine base at the right-hand side, where it is convenient for the operator to reach it.

The Hoe power-bending machine was easily adapted to individual drive by bolting cross straps to the struts between legs on which to mount the motor and a small jack shaft. In the cases referred to, where straps have been mentioned, as well as in the instances about to be alluded to, ¼-in. by 2-in. (6-mm. by 5-cm.) bars were used almost without exception. The angle irons were chiefly of the size having 2½-in. (6.2-cm.) legs. On this particular machine the control was fastened to two vertical straps, which in turn were bolted to the side of the table.

By bolting a motor directly to the back of the Ostrander plate-shaving machine it was possible to connect it with the ordinary driving pulley of the machine without any belt tightener or idler, as in the case of the Wesel planer. The control was bolted to the left-hand side of the machine next to the front, making it convenient to run conduit straight to the motor as well as to the feeder below.

To drive the Hoe beveler the guide pulleys at the back of the machine (ordinarily used to guide the belt from an overhead horizontal shaft to the vertical-shaft pulley driving the cutters) were turned 180 deg. around the rod carrying them, so that the belt could be connected with a motor below, mounted on the base of the machine. Unlike the case when the original drive was used, however, the guide-pulley rod vibrated when the machine was in operation, and it was therefore braced from the base below as well as from the back right-hand side of the machine. The control was mounted at the front of the machine on two vertical straps bent at their lower ends and bolted to a horizontal strap attached to the machine pedestal. The upper ends of the vertical straps were fastened to the front of the machine casting just below the table.

Operation of the jig saw was easily accomplished by bolting the motor to horizontal angle irons fastened to the machine pedestal in such a way that a belt could be connected between the motor and ordinary driving pulley of the machine. The control was fastened to two brackets made of strap iron screwed to the under side of the table.

Since the driving pulley of the drill press was attached to the back of the column about half way down its length, the motor was mounted directly below it on the ends of a U-shaped strap iron bolted to the bottom of the column. Footing for the motor was afforded by two straps laid across the U-shaped strap and held thereto by bolts passing through similarly placed cross-straps on the other side of the U-strap (see Fig. 2F). Changes in drill speed can be accomplished by shifting the belt on the cone pulleys which formed a part of the original installation. The control is attached to the left-hand side of drill-press column near the top.

Two Hoe wax-molding presses are installed, but one of them was purchased since the change to individual drive was made and was built for that service. How-

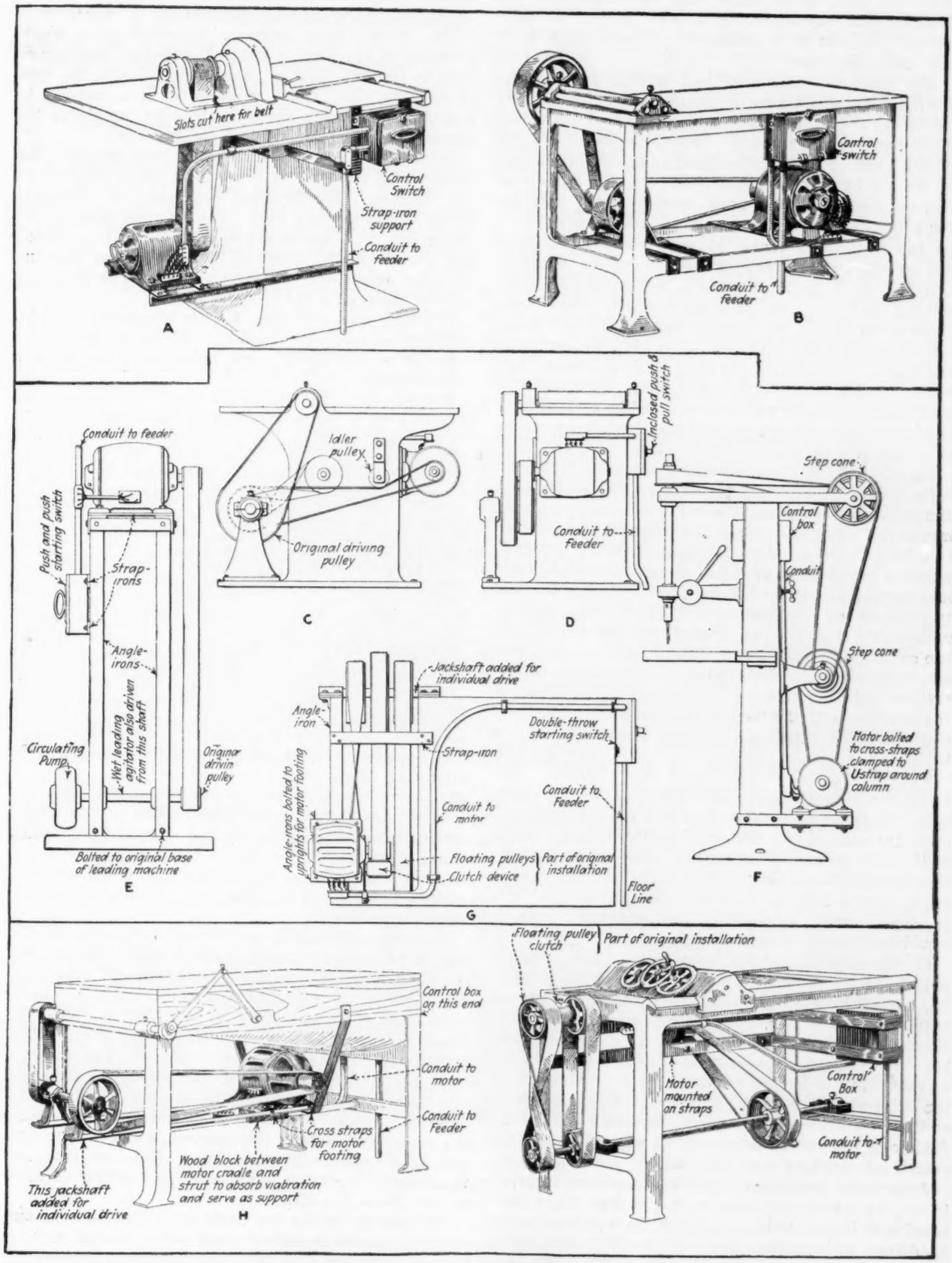


FIG. 2—METHODS OF APPLYING INDIVIDUAL DRIVE

A—Electrotype trimmer. B—Power bending machine. C and D—Type-high planer. E—Pedestal built at one end of wet-leading machine. F—Drill press. G—Wax molding press. H—Dry-leading machine. I—Wax shaver.

ever, the 7-hp. motor which was furnished with the machine was supplanted by a 3-hp. motor, as tests showed this size to be sufficient. This machine is of the hydraulic type.

The other molding press had driving pulleys near the floor line, which were originally driven from a shaft below the floor. To adapt this machine to individual drive two angle irons were fastened vertically to the extreme end of the machine base, as shown, and joined at the top by another angle iron. On this cross-piece and on the top of the press were mounted bearings for a counter shaft carrying three pulleys, one driven by the motor, one connected by a crossed belt with one of the original driving pulleys of the machine, and the third by an uncrossed belt with the other driving pulley. Two horizontal angle irons were fastened to one of the vertical angle irons previously mentioned near the floor line to provide for mounting the motor. The control for both of these presses consisted of double-throw four-pole knife switches with starting and running positions mounted in steel cabinets and connected with the motors and feeders by means of conduits.

To adapt the Hoe wax-shaving machine to individual drive required the installation of a counter shaft under the table and mounting the motor on two horizontal straps run along one side of the machine and attached to the legs. The counter shaft is supported in bearings attached to struts between legs at each end of the table and carries one pulley opposite the motor pulley and two others on the end under the original driving pulleys of the shaver. A crossed belt is used between one set of pulleys and a straight belt between the other set, to give the forward and return movement of the cutting tool. The control is mounted at the front of the machine and is attached to two horizontal straps bolted to those carrying the motor and one leg of the table.

Two metal saws are used—both shop products. One is of the pedestal type and the other of the table type. To support the motor on the pedestal-type machine the ends of two horizontal straps were curved to fit the pedestal and bolted thereto. Belt connection was then made between the motor and the original driving pulley of the saw. The control was fastened to two ⊔-shaped straps attached to the pedestal where it would be convenient to reach.

On the other metal saw, wood saw and dovetailing machine, the motors were mounted similarly by attaching them to horizontal straps fastened across two of the table legs. The control boxes were fastened to short horizontal straps attached to only one table leg. Belt connections were made direct to the original driven pulley in each case, or at least to a pulley on the original driven shaft, but moved under the table so that it would not extend into the aisle. This modification of placing the driven pulley where it would not extend into working space was made in numerous cases.

Apparently unnecessary complications were incurred in driving the nailing machine, but it must be remembered that it was decided to use 1800-r.p.m. motors for all drives, and, besides, they had to be placed where they would not occupy valuable space. With this machine, which has a pulley at the top, it was necessary to cut away the base to run a vertical belt to a countershaft below the bench on which the machine sits. Between this countershaft and the motor was another countershaft. All this mechanism occupies space under the bench that would only collect rubbish otherwise.

The Wesel rotary trimmer is driven by a motor mounted on two vertical straps fastened at their upper ends to the table and at their lower ends to the base of the table. The motor is connected by a coupling to a shaft that extends inside the housing containing the regular driving mechanism of the trimmer.

Direct drive is used on the solid body trimmer, the motor being mounted on brackets at the pulley end of the machine. The brackets are made of ⌐-shaped straps braced between ends. The coupling between the motor and the trimmer serves as a pulley from which two emery wheels, mounted in front of the machine on strap extensions, are driven. These emery wheels are for sharpening the trimmer tools.

A rotary planer is used, but its adaptation to individual drive was very simple, as the motor was easily mounted on horizontal angle irons bolted to the machine pedestal.

A curved and a flat router are used. The curved type is driven by a motor attached to the right-hand side of the column and a belt passing over the ordinary guide pulleys at this side of the machine. The control is attached to two vertical straps fastened to the top right-hand side of the machine, thus making a very short run necessary between switch and motor. For the flat router it was only necessary to fasten horizontal angle irons to the pedestal and attach the motor thereto, using a crossed belt to drive the vertical-shaft pulley under the table.

RATING OF MOTORS* DRIVING ELECTROTYPING MACHINES

Machine Driven	Hp. of Motor	Machine Driven	Hp. of Motor
Drill press	½	Disk trimmer	1
Jig saw	½	Curved router	½
Beveling machine	1½	Nailing machine	½
Shaving machine	1	Wood saw	1
Dovetailing machine	½	Metal saw	1
Curving machine	1	Small saw	½
Type-high planer	1	Roughing machine	1½
Turning machine	½	Two molding presses, each	3
Flat routing machine	½	Generator (electroplating)	5
Saw sharpener	½	Wet leading	1
Solid trimmer	½	Dry leading	½
Rotary planer	½		

* All 1800-r.p.m., 60-cycle, 220-volt induction motors.

Both the wet-leading and dry-leading processes are used in this plant for making electrotypes. In converting the wet-leading machine to individual drive four tall angle irons were erected in the form of a column to support the motor about 5 ft. (1.5 m.) above the floor so that a vertical belt drive could be used to operate the agitator and pump below. The tops of each pair of angles forming the column were joined by an angle iron and straps used to join the pairs thus secured. Across the angles were laid straps to which the motor was bolted. The control is fastened to one side of this column by cross-straps. One conduit serves to connect the control box, feeder and motor, as may be seen from Fig. 2E.

The motor for the dry-leading machine is mounted under it on a cradle made of strap iron. Its construction is best shown by Fig. 2H. The pipe strut connecting the two pairs of legs runs under the cradle and is bolted thereto but separated from it by a wooden block which takes up the vibration yet permits full utilization of the strut.

LIGHTING FOR PRODUCTION IN FINE WEAVING PLANT

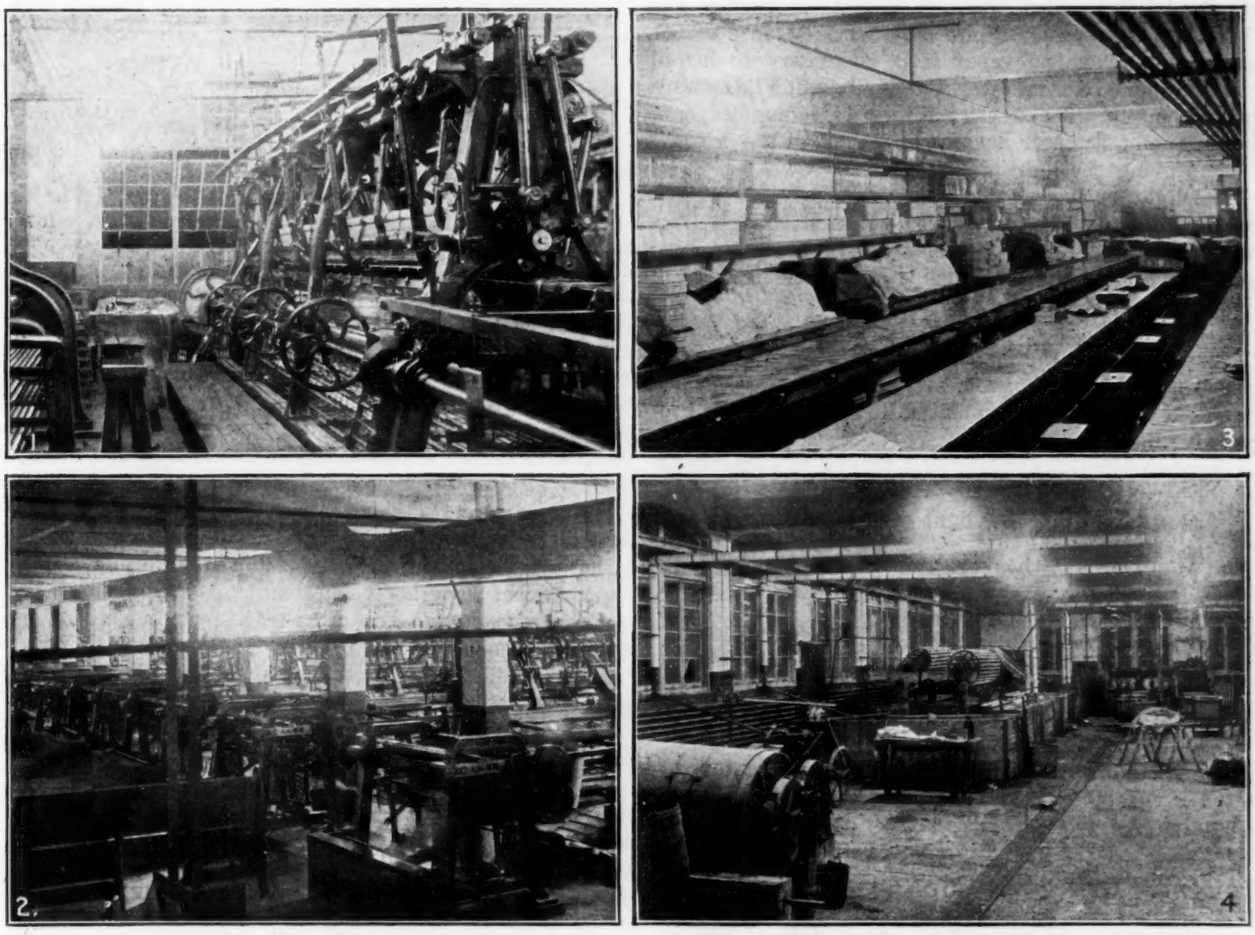
High-Intensity Lighting Found Very Important—Promotes Quality of Work and Production, Cleanliness and Morale

E. DU B. STRYKER
Engineering Department, National Lamp Works of General Electric Company

IN VIEW of the publicity which the engineering press has given recently to the advantages of high lighting intensities properly employed, the movement for the installation of industrial lighting systems designed to increase production should gain considerable headway. The actual figures on the productive value of good illumination come as a fitting climax to the progress made in this field during the war. Many progressive executives, however, have already learned to appreciate the productive value and psychological effect of high-intensity lighting from their own practical experiments. Without the services of a competent illuminating engineer, and with little knowledge of the finer points of lighting, these men have had systems installed which provide what they consider the necessary amount of light; and even though the results obtained are not always beyond the criticism of the illuminating engineer, these installations have in a number of cases brought gratifying results to their initiators.

One very commendable example of such an installation may be found in the plant of E. & Z. Van Raalte, just outside of New York City. There is considerable fine detail in the work—the weaving of veilings, nets and similar textiles—and the management felt that a reduction in spoilage and waste would of itself repay the small added expense incurred by better lighting. The psychological effect of the lighting not only influenced production by keeping the employees more alert but created an attitude of satisfaction among them as well.

The machine shown in Fig. 1 is a veiling loom on which many hundred veils are made in one piece, to be cut apart and packed in subsequent operations. The operative is required to watch the individual threads as they feed from below and are woven in intricate designs by this superhuman machine. It is essential that good lighting be provided on both horizontal and vertical surfaces. To accomplish this two units are mounted 13 ft. (4 m.) above the floor, 5 ft. (1.5 m.) apart and at such a distance from the machine that they will be directly over the head of the operative, thus avoiding bad shadows. The units which are mounted in front of the next machine also assist in the avoidance of shadow since they illuminate the first machine from the rear. Fig. 2 shows a general view of the machine from the rear. Two 500-watt gas-filled clear-bulb lamps in totally inclosing light-opal balls provide a horizontal



FIGS. 1, 2, 3 AND 4—ILLUMINATION OF ROOMS IN FACTORY DEVOTED TO FINE WEAVING

(1) Absence of shadow characterizes the lighting of this large veiling loom. (2) The general cleanliness of the plant helps the lighting to produce a bright, cheerful appearance. (3) The girls who work here have no trouble in properly cutting and packing the veils. (4) The dye house for raw silk. Note uniform illumination.

and vertical intensity at the working plane of 10 ft.-candles and 7 ft.-candles respectively.

After the veiling is removed from the loom and has been stretched, it is cut in long strips. These strips are then run down the tables shown in Fig. 3, where they are cut into individual veils by hand and packed for the consumer. Here again the units consist of 500-watt gas-filled lamps in totally inclosing light-opal balls, mounted 11 ft. (3.3 m.) above the floor at intervals of 18 ft. (5.5 m.). The intensity on the top of the tables averages 10 ft.-candles. From the standpoint of shadow it would have been preferable to use two rows of units in this room with 300-watt lamps. If the covering on the table tops were finished with a flat, rather than a glossy, covering, specular reflection would be avoided.

The dye house (Fig. 4) is lighted by two rows of 200-watt gas-filled lamps in enameled-steel dome reflectors mounted 14 ft. (4.3 m.) above the floor on 10-ft. by 18-ft. (3-m. by 5.5-m.) rectangles. Note the uniformity of illumination and the absence of shadow. Horizontal and vertical intensities of 11 ft.-candles and 7 ft.-candles respectively are obtained. Because of the presence of chemical vapor it is customary to install either vapor-proof units or totally inclosing glassware in dye houses. The steel reflectors were installed here intentionally, however, as an experiment in the interest of improving the lighting.

The lighting in this plant shows the advantage of a properly installed high-intensity system of general overhead lighting. Fig. 1 presents an intricate machine of large dimensions in which every detail is so well lighted that local lighting with lamps on drop cords is rarely resorted to. Not the least important feature of the installation is the maintenance of the units and the reflecting surfaces of walls and ceilings. The obvious cleanliness of the entire plant is indicative of the progressive methods employed. The walls are finished in dark-green paint to a height of 5 ft. (1.5 m.); the finish of the remainder of the walls, together with the ceilings, is a flat white. Daylight conditions are also good in this establishment.

MY CRITICISM is not of the magnitude but of the method of our tax measures. My point is that we have omitted to impose certain easily borne, easily collected, greatly productive and well-tested taxes, such as—to quote only one minor but characteristic instance—a stamp tax on checks, and have grossly maladjudged others, with the result that our revenue legislation has largely contributed to throw our economic equilibrium out of gear—to the detriment of everybody, and particularly to the great cost and damage of the masses of the people. I realize, of course, that even if strict governmental economy is practiced, we are faced with the necessity of raising a vast sum of money annually by taxation. But I am convinced that the needed amount can and should be raised with far less complexity, vexation and economic dislocation and disadvantage than have resulted and were bound to result from the revenue measures now in force.—*Otto H. Kahn.*

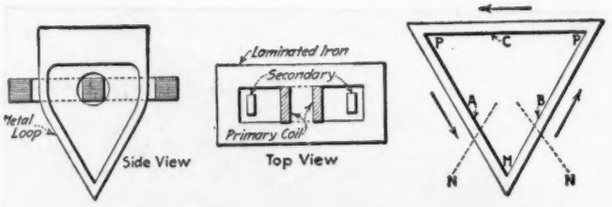
OPERATING BRASS-MAKING INDUCTION FURNACES

Experience Dealing with Problems of Furnace Lining, Charging, Mixing of Zinc and Removal of Zinc Oxide Deposit

BY R. N. BLAKESLEE, JR.

EXPERIENCE with induction furnaces of the Ajax-Wyatt type, in its application to the making of brass billets for extrusion purposes, leads the author to offer suggestions to facilitate economical operation. Considerable care must be taken to maintain proper temperature and to keep the metal from "freezing." The inherent characteristics of the induction furnace for brass making, also, are rather fully discussed.

The Ajax-Wyatt furnace is a single-phase induction furnace, or merely a one-turn secondary transformer with a portion of the metal itself forming the secondary winding. This portion of the metal which forms the



FIGS. 1 AND 2—ARRANGEMENT OF INDUCTION FURNACE SHOWING (1) PRIMARY AND SECONDARY COILS AND (2) PRODUCTION OF MOTOR EFFECT IN SECONDARY LOOP

heating element is a loop brought down below the main furnace chamber. The effect of the submerged loop is to put the heating element under pressure and thereby reduce the tendency for the zinc to vaporize. The transformer is a three-legged or H type and the secondary loop surrounds the middle leg. The exciting or primary coil is also on this leg.

The particular furnace with which the author is familiar is built for 60-cycle, 220-volt, single-phase energy. The primary turns of the transformer are so apportioned as to apply approximately 4 volts pressure at the secondary. The cross-section of the secondary channel is about 3⅜ in. by ⅝ in. (8.58 cm. by 1.5 cm.), and when filled with molten metal the resistance is such that about 10,000 amp. flow, causing a rapid heating of the brass. The primary input is about 200 amp. and 35 kw. at a power factor of from 80 to 90 per cent.

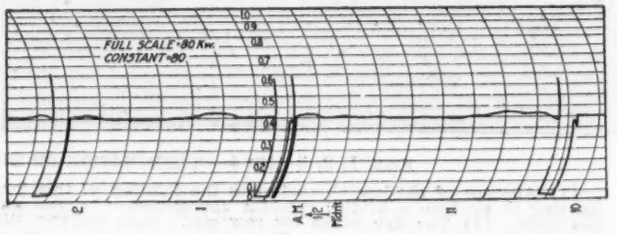


FIG. 3—CHART SHOWING POWER REQUIREMENTS OF INDUCTION FURNACE

The shell which forms the outside of the furnace is first lined with "Sil-o-Cell" heat-insulating brick, and the inner lining which forms the chamber and duct is made of high temperature cement.

The principal advantages of the induction-type furnace are:

(a) *Simplicity of Control.*—A simple panel with a fused knife switch and ammeter and an integrating watt-hour meter will suffice. The furnace is readily adapted to standard three-phase circuits because it is easy to balance the small units on the various phases. Furnaces can be wound to operate on 110, 220, 440 and 550 volts, although 220 is probably the better voltage. Sizes have been built from 30 kw. up to 90 kw. Ordinary distributing transformers will furnish power satisfactorily since there are no surges such as are experienced with arc furnaces.

(b) *Simplicity of Mechanical Design.*—When a freeze-up or other trouble occurs the old lining can be removed and a new one installed without difficulty. The new materials for a lining and the necessary labor cost approximately less than $100. An average life should produce 150,000 lb. (68,000 kg.) of metal, and linings have gone as high as 750,000 lb. (340,000 kg.). It is apparent that the lining charge per pound of metal is much less than the corresponding charge for crucibles.

(c) *Low Energy Consumption.*—Since the heating element is the metal itself, there is no heat transfer to introduce losses. A fair value for metal melted is 8 lb. (3.6 kg.) per kilowatt-hour. This cost will probably a little more than balance the cost of oil or coal and coke in pit fires.

Data of a test run on a typical furnace are given in the accompanying table.

DATA ON TEST RUN WITH TYPICAL FURNACE

Billet No.	Time Start	Time Pour	Av. Volts	Av. Amp.	Av. Kw.	Av. P. F.	Weight Charged	Weight Poured	Kw.-Hr. Used	Lb. Charged per Kw.-Hr.	Lb. Poured per Kw.-Hr.
1	1:55	3:11	212	214	37.5	82	407	315	40	10.17	7.87
2	3:17	4:27	212.5	216.1	37.65	82	462	323	44	10.5	7.35
3	4:32	5:25	212	214	37.6	82.9	318.7	326.4	35	9.11	9.34
4	5:30	6:26	212.9	213.7	37.6	82.6	339.5	321.7	34	9.97	9.46
5	6:31	7:29	213.8	215.9	37.2	80.7	320.5	321	35	9.16	9.17
6	7:36	8:37	213.7	221	38.7	82	374	326.25	38	9.86	8.58
7	8:44	9:40	213.3	224.4	38.55	80.5	365.25	326	37	10.15	8.81

Average kilowatt = 37.8
Average volts = 212.9
Average amp. = 217.0
Average power factor = 81.8

Average pounds charged per kw.-hr. = 9.63
Average pounds poured per kw.-hr. = 8.6
Average pounds poured per hour = 291
Average pounds charged per hour = 328

The difference in weight charged and poured is in skimmings, in the form of fine brass particles and zinc oxide, or in the dirt, which was weighed as metal.

(d) *Automatic Mixing of the Metal.*—An examination of the sketch of the type of furnace under discussion will show that the secondary loop is merely an inverted delta. If at any instant the current in leg *A* has the direction shown by the arrow, then the currents in legs *C* and *B* will also have the directions shown. Legs *A* and *B* are conductors carrying currents in opposite directions and will tend to repel each other. It is obvious that the maximum repulsion occurs at *M* and much less at *N-N*. This differential repulsion, called the *motor effect*, with fluid conductors, sets up circulating streams of metal. In fact, an examination of a furnace in operation will reveal the fact that the top surface of the metal bath has a strong resemblance to a bubbling spring. All this bubbling or stirring action results in a thoroughly mixed metal. The effect of well-mixed metal is cumulative, since the scrap from the product, which must be used again, is closer to the mixture.

Incidentally one contributing factor in the excellent mixture control is the very low zinc loss. Pit fires have a spelter loss of from 1½ per cent to 2 per cent. The induction furnace has a spelter loss close to ½ per cent, and this is very constant throughout the life of furnace. A casting shop using only induction furnaces has noticeably little spelter vapor in the air, is much cooler and forms a better working place for the men. In an experience of more than two years the Bridgeport Brass Company has not had one authentic case of "spelter chills." It has also been noticeable that instances of severe burns, the result frequently of breaking pots in pit fire casting, have practically disappeared.

(e) *Cheaper Labor.*—Provided the charge to be melted is weighed under the supervision of a metallurgist, which is the case in most shops, the experienced caster with a knowledge of metal mixtures, fluxes, etc., is not needed. The operator should be able to gage the temperature of the metal, know how to dress the mold and understand the rates of pouring and shrinking. A green man can be readily trained for the job.

(f) *Field of Utility.*—The furnace is applicable to sand and iron mold casting of all brasses from 50 per cent copper to 90 per cent. Lead mixtures of over 3½ per cent will be apt to cause trouble.

(g) *Better Shrinking and Pouring.*—For products that must be shrunk the addition of hot metal from a constant-temperature source, such as a furnace chamber, results in decidedly better gates than are possible from pots or bull ladles. The arrangement of the furnace tilting by means of a simple hand-wheel is an extremely good pouring method.

LIMITATIONS OF INDUCTION FURNACES

The disadvantages of the induction furnace are mainly as follows:

(a) *Twenty-four-Hour Operation.*—Should the power be off from the furnace for longer than twenty to thirty minutes the metal in the duct or loop freezes and in freezing contracts and pulls apart, so that with the resumption of power there is no contact and consequently no heating. The furnace must be torn down and relined. It is possible, however, to reduce the voltage on the furnace approximately half, so that the power input is just enough to overcome the radiation and thus hold the furnace. As this holding power is about 8 kw., the energy cost for ten-hour operation is too high. Also it is necessary to have at least one man present to watch for freeze-up.

(b) *Mixture Limitations.*—Non-application to highly leaded mixtures or to brass with a copper content of 90 per cent or over.

(c) *Lack of Flexibility.*—If a furnace is running on a leaded or tinned mixture, it cannot be changed to a pure copper-spelter mixture without either causing scrap or dumping furnace and restarting.

Experience has shown that particular pains must be taken with the ramming up of the refractory. The high-temperature cement comes in a form of sand and must be mixed to correct consistency with water and silicate of soda. It should be rammed in with air hammers while moist. The duct or loop is formed by ramming into the lining a brass core or casting which has the correct size and shape. Special care should be taken that the core is smooth. This core is afterward melted out and forms the duct, which is the heating element. When the furnace is rammed it should dry in air twenty-four hours and then be dried in an oven for about three days more. At the end of drying, a good charcoal fire or gas torch should raise the temperature steadily at the rate of 300 deg. an hour, so that the addition of molten zinc, which is used to melt out the brass pattern which forms the secondary loop, will not shock the refractory. Power at reduced voltage must then be applied until the brass pattern is melted, when cold brass can be slowly charged. Thus the level of metal is slowly raised to a point just under the spout.

The charge to be melted should be complete in a box or can. The operator, removing spelter so as to charge this last, charges copper ingots and scrap first to insure its being completely melted. The light brass scrap with the heavier on top follows.

When the charge is melted and sufficiently hot the zinc is added. Temperature can be judged by the eye or pyrometer, or by placing a skimmer in the furnace and noting the temperature at which it vibrates. The zinc will melt immediately, but power should be left on two or three minutes to give time for thorough mixing. The furnace should then be skimmed to remove dross, oxide, etc., and poured.

When pouring, care must be taken that too much metal is not removed. Sufficient residual metal must be left to form the secondary loop.

REMOVAL OF ZINC OXIDE

When a furnace has been in operation several days, the zinc oxide will begin to build up on the inside of the chamber. This, of course, reduces its metal capacity, and it is at this time that care must be taken not to pour the furnace too dry. Fortunately this zinc oxide, if not allowed to remain too long, is fairly soft and may be removed with a light sledge and bar. A better method is to use a heavy air hammer with "Hi-speed" steel tools. The furnace should be chipped out every two or three days.

One effect readily noticeable in the induction type of furnace is called "spelter kicks." If the metal in the loop becomes too hot, zinc vapor forms. This vapor has a much higher resistance than molten brass, and when it forms the current and power input to furnace is made very low. The ammeter needle will kick back from normal to a very low value and back again to normal. The pulsations occur two or three times a second. The ammeter needle is then a good check on the furnace operation. If the needle kicks, the operator is either failing to poke the cold charge down into the hot bath or he has overheated the metal.

Overheating continuously has two bad effects. It slows down the furnace capacity and softens the refractory lining, shortening its life considerably. The usual effect is that lining develops cracks through which metal runs, and the lining, and oftentimes the primary coil, is ruined.

The use of a graphic wattmeter or ammeter gives an excellent check on furnace.

Fig. 3 is a chart from a graphic wattmeter placed on a typical furnace. Places where the chart shows zero power represent the pouring of a billet. During the melting period slight variations in power may be observed. This variation is due to change in resistance of metal in the loop as well as line voltage variation. The metal in the loop is chilled when cold metal is charged, and this lowers its resistance. An examination of the chart will show that just before the second pour the operator allowed the metal to become too hot. The chart shows a "spelter kick."

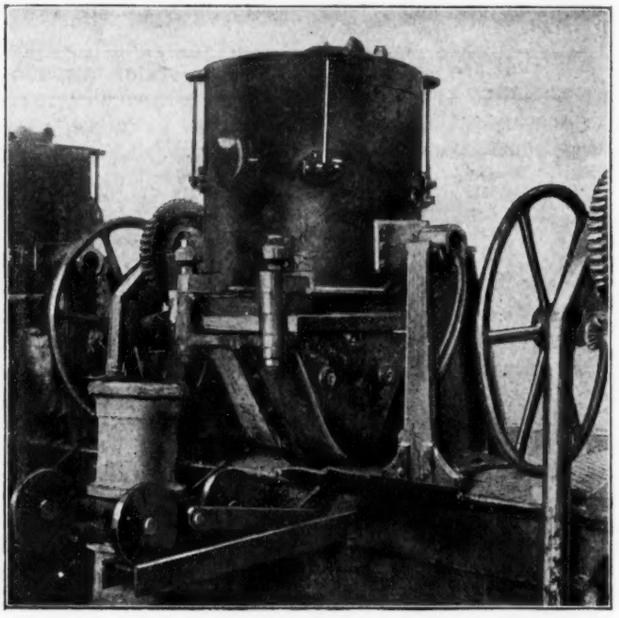


FIG. 4—GENERAL VIEW OF 35-KW. AJAX-WYATT FURNACE

It has been found that with the correct operation, as described, the billet is much better than can be made with the old pit fire. It is closer to the mixture, has better surface, lower scrap, which is the result of good shrinking, and better grain structure. It is possible to reduce the scrap on a 7-in. (18-cm.) diameter billet weighing 350 lb. (159 kg.) to 5 lb. (2.3 kg.).

IN JUSTICE to ourselves we must be diligent and aggressive. We must conserve our strength and our resources. We must view the world situation from the point of experience, caution and wisdom. We should profit by the deliberations, discussions and conclusions of others. As of vital consequence there should be the most consistent and intense spirit of coöperation between all our people, between capital and labor, employers and employees, between the state and private interests, between the various groups of individuals or collections of individuals, between producers and consumers, between professionals and non-professionals.—*E. H. Gary.*

Organizing Electrical Inspection and Maintenance

Rigid Inspection of Electrical Apparatus on a Definite Time Schedule Results in Negligible Interruption of Industrial Plant Production—Organization of Crews with Well-Defined Duties Fixes Responsibilities and Promotes Efficient Maintenance

BY C. A. COWDERY

THE method of electrical inspection and maintenance outlined in the succeeding paragraphs was carried out in one of the large industrial plants in New England while the factory was employed on war work exclusively and operated twenty-four hours daily excepting Sundays. As production was of first consideration, every precaution possible was taken to insure uninterrupted operation. The organization of the electrical department, as shown by the chart, however, is applicable to a plant on peace-time production with slight changes to allow for the manufacturing force working only eight hours a day, instead of twenty-four hours as under war conditions.

In order to insure a minimum number of interruptions to production due to failure of electrical apparatus, the apparatus must be subjected to a systematic inspection so that incipient faults may be corrected. The policy of "trusting to luck" and waiting for the breakdown to occur may result in interrupting the flow of work in the whole plant as well as affecting the department in which the shutdown occurs. Frequent interruptions also tend to cause dissatisfaction among the workmen, especially if they are on a piece-rate basis. With labor conditions in their present state of unrest this is worth consideration.

The plant under discussion has been operating more than four years and to date has only had seventeen cases of shut-down due to motor troubles in the operation of an average of 500 motors on a twenty-four-hour basis most of the time. Eight of these cases were due to causes external to the motor, such as factory trucks injuring the compensators and flying belts allowing the oil to escape from the bearings. The time of shutdown averaged two hours each, the minimum being one-half hour and the maximum four hours, the latter being caused by trouble with a motor in the forge shop difficult to get at.

FEW BUT RELIABLE TYPES OF APPARATUS SHOULD BE USED

The cost of maintaining the apparatus after it is installed depends to a large extent on the proper selection of the apparatus. and in the long run the best make of material for the particular use it will be put to will more than repay for the increased initial investment over some cheaper make. Fewer makes of apparatus used, motors for instance, will also tend to reduce the cost of maintenance, (1) by reducing the number of spare parts necessary to carry in stock and (2) owing to the fact that with only one make of a certain apparatus the maintenance man can become fully familiar with the construction and weak points of the particular make. It will also simplify the stock of chain pinions and pulley bushings to be carried by the millwright department as there will not be a number of different-shaft diameters for the same size of motor. The standardization of starting apparatus, etc., not only helps the maintenance men but also tends to decrease the cost of repairs because the workmen are not confronted by new types of apparatus when changing from one department to another. In the case of group drives it further reduces the cost of

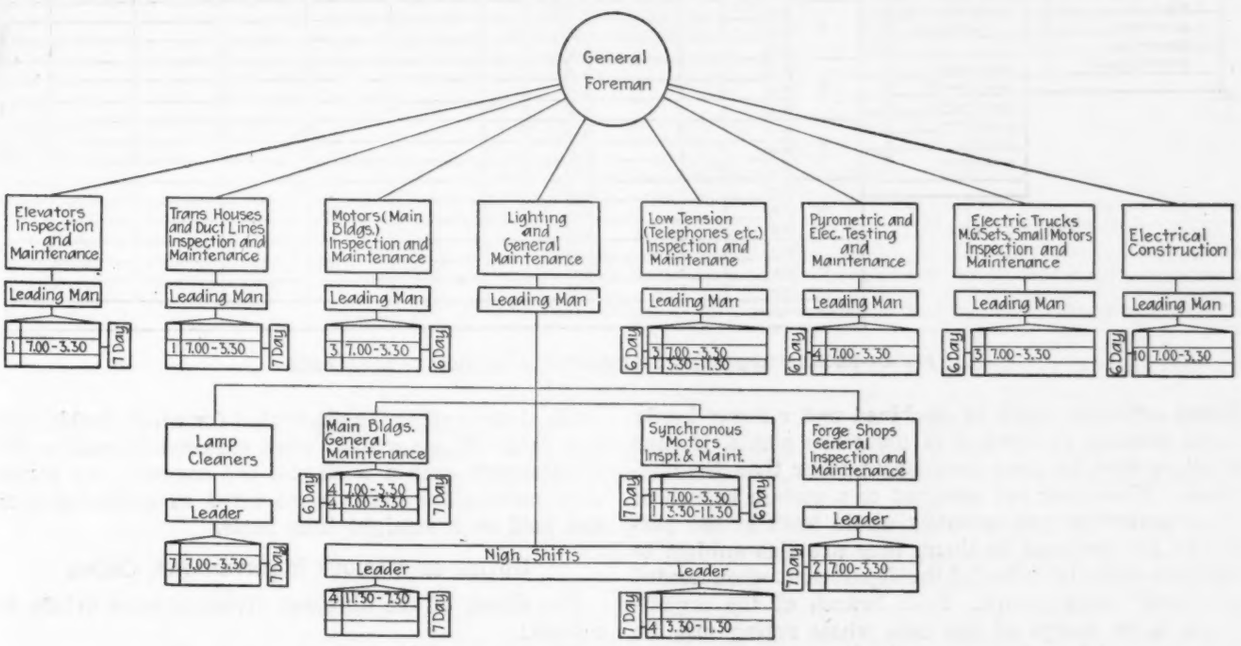

General Foreman
Elevators Inspection and Maintenance
Trans. Houses and Duct Lines Inspection and Maintenance
Motors (Main Bldgs.) Inspection and Maintenance
Lighting and General Maintenance
Low Tension (Telephones etc.) Inspection and Maintenane
Pyrometric and Elec. Testing and Maintenance
Electric Trucks M.G.Sets, Small Motors Inspection and Maintenance
Electrical Construction
Leading Man
Lamp Cleaners
Leader
Main Bldgs. General Maintenance
Synchronous Motors, Inspt. & Maint.
Forge Shops General Inspection and Maintenance
Night Shifts
7 Day
6 Day

FIG. 1—ORGANIZATION CHART FOR INDUSTRIAL PLANT USING 500 MOTORS AGGREGATING 9000 HP.

necessary stock of driving pinions, pulleys, etc., if the motors are standardized as to speed. Installation costs are also reduced owing to the familiarity of workmen with the standard types.

ORGANIZING WORKMEN INTO GROUPS

The form of organization shown covers the inspection and maintenance of a plant operating an average of 500 motors, aggregating over 9000 hp., with twenty-four-hour operation of the manufacturing sections. This form is adaptable to a larger plant without much change, but for a plant considerably smaller the different activities could be combined under fewer heads. Lamp cleaning as handled in numerous plants, if done at all, is done by some department other than the electrical. While men are assigned to a certain branch of the organization and normally would work at the particular job assigned to them, they are also subject to call from other branches of the department when needed for "rush" repair work. Each branch of the organization is in charge of one man whose rating may be foreman, assistant foreman or leading man, depending on the size of the branch. The men report to the leader of their division on all subjects, and he in turn reports to the general foreman all matters of importance or for advice. Written reports are read by the general foreman, signed and placed on file for reference. All hiring and discharging of help is in the hands of the general foreman and cannot be done by the men in charge of the divisions. The two night shifts are operated with men paid on a seven-day basis and allowed straight time only. As all of the men employed on the day shift were not needed on Sundays, it was decided to have those men come in whose line of work required them for the particular class of apparatus due for stand-still inspection that day. This plan resulted in having the men on hand who were more familiar with the apparatus under test and did not bring the same men in every Sunday. One-half of the regular day maintenance force who served as general maintenance men were rated as seven-day men and were used to help out with the particular line of inspection being carried on at that time and under the direction of the man in charge, who was brought in for that line of inspection. This plan, of course, would not be advisable for a factory working one shift as repairs could be made at some other time than that for which double time was paid. Where certain work required inspection and maintenance once a week, as, for example, the forge-shop motors, the crews were rated as seven-day men and paid on a straight time basis.

ELEVATOR INSPECTION REPORT 191

ELEVATOR	1	2	3	4	5	6	7	8	9	10	11	12	13	14
MOTOR														
BEARINGS														
BRUSHES														
CONNECTIONS														
CONTROLLER														
CONTACTS														
CONNECTIONS														
GRID CONNECTIONS														
AUTO-RHEOSTAT														
POTENTIAL SWITCH														
MAIN SWITCH														
FUSES														
LIGHT ON CAR														
ANNUNCIATOR														
PUSH-BUTTONS														
SAFETY SWITCHES														
MONTHLY TEST														
CAR & GATES														
CABLE-DRUM														
CABLE-CAR														
CABLE-COUNTER														
CABLE-CONTROL														
BRAKE														
ALL BEARINGS														
CABLE-WHEELS														
APPARATUS CLEAN														

SYNCHRONOUS MOTOR INSPECTION REPORT 191

NUMBER	1	2	3	4	5	6	7	8	9	10	11	12
MOTOR												
BEARINGS												
BRUSHES												
TEMPERATURE												
CONNECTIONS												
EXCITER												
BEARINGS												
BRUSHES												
COMMUTATOR												
CONNECTIONS												
SWITCHBOARD												
SWITCHES												
METERS												
RHEOSTAT												
CONNECTIONS												
APPARATUS CLEAN												
MOTOR ROOM CLEAN												
ROOM TEMPARATURE												
AMMETER READING												
SWITCH RESER-												
VOIRS LOWERED												
AND INSPECTION												
MADE OF CON-												
TACTS, ETC.												
(EACH MONTH)												

TRANSFORMER HOUSE INSPECTION REPORT 191

TRANSFORMER HOUSE	POWER TRANSFORMERS TEMP	POWER TRANSFORMERS OIL LEVEL	POWER TRANSFORMERS REMARKS	LIGHTING TRANSFORMERS TEMP	LIGHTING TRANSFORMERS OIL LEVEL	LIGHTING TRANSFORMERS REMARKS	H. T. SWITCHES	L. T. SWITCH BD.	BLDG. INTERIOR	MANHOLS	HOUSE TEMP.
1	P.-1			L.-1							
	P.-2			L.-2							
	P.-3			L.-3							
2	P.-1			L.-1							
	P.-2			L.-2							
	P.-3			L.-3							
3	P.-1			L.-1							
	P.-2			L.-2							
	P.-3			L.-3							
4	P.-1			L.-1							
	P.-2			L.-2							
	P.-3			L.-3							
5	P.-1			L.-1							
	P.-2			L.-2							
	P.-3			L.-3							
6	P.-1			L.-1							
	P.-2			L.-2							
	P.-3			L.-3							
7	P.-1			L.-1							
	P.-2			L.-2							
	P.-3			L.-3							
8	P.-1			L.-1							
	P.-2			L.-2							
	P.-3			L.-3							
9	P.-1			L.-1							
	P.-2			L.-2							
	P.-3			L.-3							

OUTSIDE TEMPERATURE SIGNED

OVER

FIG. 2—RECORDS REQUIRING SYSTEMATIC INSPECTION OF APPARATUS

DUTIES OF VARIOUS MAINTENANCE CREWS

The duties of the different divisions were briefly as follows:

The construction crew installed all new work requiring piping and wiring needed in any of the other departments as well as any work caused by the change of location of any of the apparatus already installed. As the factory was recently erected there was much more of this class of work than would be found in a factory of established production which accounts for the number of men employed in this division. Moreover, because of new contracts and the extension of old ones there was a great amount of work in the rearrangement of motor and lighting layouts to accommodate new arrangements of the machinery. The average general maintenance man does not qualify as a wireman

capable of doing pipe work, and it is more economical to employ a few regular wiremen, who will do the work much quicker and better than one not acquainted with this line of work. After a factory is settled on a standard line of work the construction force would be greatly reduced, if not done away with, in the majority of plants, and what work did come up of this nature could be taken care of by the maintenance crew. The type of the construction throughout the factory was standardized as much as possible so as to reduce the number of fittings needed and to increase the ease of installing by the construction crew.

The department in charge of electric trucks, motor-generator sets and small motors consisted of inspection and maintenance men. The electrical maintenance of the twenty-one battery-type trucks used throughout the plant consisted in inspection and maintenance of all electrical parts of the trucks, as batteries, motors, controllers and bells. Motor-generator sets and panels for charging batteries were under the control of this department. The trucks were thoroughly cleaned at regular times. All motor-generators were inspected and maintained by this division. A time schedule was followed for this work, the record of the time of inspection being made by the use of a Newmans watchmen's clock. This insured the proper voltage and the proper care of the commutators. The numerous small motors, such as those used on tabulating machines, adding machines, desk fans, blueprint machines and other miscellaneous apparatus of this nature, were subjected to a regular inspection by men of this crew, who oiled and cleaned at the time of the inspection. This class of apparatus is very liable to be overlooked in many plants, but should have attention the same as any other piece of machinery. Any rewinding of these small motors necessary was done by this same department. Card records are kept as to the location, make, etc., of all such apparatus.

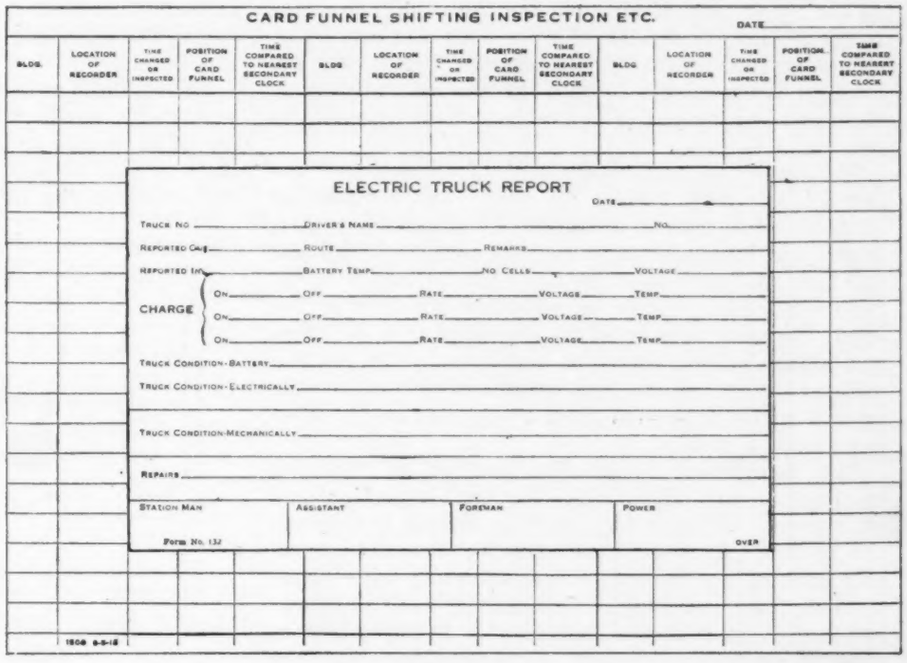


FIG. 3—ADDITIONAL INFORMATION IS RECORDED ON THE BACK OF TWO CHARTS SHOWN

The pyrometric and electrical testing department is one which in a smaller plant would probably not exist, although the testing of motors as to proper loading should be carried on in all plants no matter how small. The pyrometric inspection and maintenance is often done by the manufacturing division, as was originally the case at this plant. If heat-measuring instruments are to be used, they must be inspected and maintained properly or they will be a detriment instead of a help, for the tendency of the average furnace man is to distrust the instruments and to rely on the eye for the proper heat, and in a majority of installations as maintained he has good cause for doubting the instrument. There are several good makes of temperature-recording instruments on the market, but there are none made which do not require checking and maintenance. The crew engaged in this work was instructed to work with the furnace operator and thereby gain his confidence if possible. This plan worked out very successfully; the operators came to believe in the readings, and perfect coöperation was obtained. The instruments were always set to read the correct temperature and no bothersome correction card was placed on the furnace. Daily checks of fire heads in the more important furnaces were carried on, while a check was made every other day on those furnaces not so important. Electrical testing in a factory of this size is necessary because of the varying loads on the motors, feeders and transformer houses. Moreover, all measuring instruments throughout the factory and switchboard instruments in the power station require periodical checking. A graphic wattmeter is a great help in studying load conditions, and from charts obtained much valuable information was gained to enable the proper assignment of motors to future drives and also the rearrangement of present ones so as to increase the efficiency of the system. As the average power factor for the plant was between 80 per cent and 85 per cent during the heaviest load, it is evident that good motor loading was obtained.

The department headed "low tension" needs defining. By this term are meant all systems using energy below 110 volts, such as telephones, time systems, fire alarms and the usual buzzer systems found in offices. The work of this department consisted of all inspection work on the systems mentioned, as well as installation and maintenance, excepting that requiring piping, which was done by the construction department. The factory is equipped with a 300-line automatic telephone set, electric time system, interior fire-alarm system and numerous buzzer and annunciator systems. The amount of work due to the change of location of departments was great and required a larger crew than would be needed in the same factory after a standard line of work was being produced.

Motor inspections and repairs included inspections, and repairs, oiling and cleaning of all motors and starting apparatus throughout the main buildings other than

those already described. No stock was carried for the rewinding of motors as there were no burn-outs requiring coils, thanks to the strict inspection kept. Certain men were assigned to a section of the factory whose duty it was to inspect each motor daily as to certain conditions described later. Whenever a motor was taken down for any reason, as for moving to another location, it was given a thorough inspection and cleaning, and if necessary the coils were varnished and baked before reinstallation.

The division caring for the transformer houses and high-tension duct systems make regular inspection trips of all transformer houses and duct lines. The Newmans watchman's clock system is used in the inspections, and thereby a record is kept as to time of the last inspection. Semi-weekly written reports are turned in to the general foreman as to the condition of the houses and apparatus. As the supply from the power station to the transformer houses is carried by an underground duct system, regular inspections are made of the manholes to note the amount of water in them and to ascertain if any cable is showing excessive heating.

The inspection and maintenance of all elevators was "up to" one man besides an oiler. The replacement of cables when needed, upkeep of all contactors, brakes, drums and hydraulic gates and the cleaning of all pits and cars was performed by this crew. Because of the twenty-four-hour use of all elevators six days of the week, the men were rated as seven-day men, as there was always some work to be performed while the elevators were shut down. Full written reports were made on most of the apparatus twice a week and on the other parts once a month.

The department under the heading of "lighting equipment" was responsible for the inspection and maintenance of the entire lighting system throughout the factory. The night maintenance men did no repair work of a permanent nature excepting the replacement of fuses and lamps. One man of each shift was required to stay at the maintenance headquarters in order to answer trouble calls, while the other men were on inspection trips, battery charging, changing of time recorders, turning on or off of the stairway, exit and yard lights as per schedule. All transformer houses, motor-generators and synchronous motors were visited once during each of the night shifts, and time of inspection was recorded on the Newmans clock carried with them. If any serious trouble developed during the night that could not be handled by the night men, men of the day crew qualified to make the repairs necessary were sent for. Three men were assigned to the forge shops on the day shift who were responsible for the inspection and maintenance of all lighting and power apparatus in the forge shops. These men were rated as seven-day men as they were required every Sunday for the inspection and cleaning of apparatus that could not be done through the week. The maintenance of lighting circuits, replacement of lamps, fuses, etc., during the day shift was carried on by a group of men who also served as helpers to other departments on request, repaired miscellaneous apparatus such as lighting fixtures, extension cords, blown fuses (renewable type), sockets, etc. This group was divided into a section whose men were rated as six-day men and a section with seven-day rating, the seven-day men being used as previously stated. The synchronous motors employed to drive the exhaust-system fans were installed on the roof in various parts of the factory and required careful inspection owing to the excessive vibration of the entire set. These were patrolled during each shift. Between inspections the men assigned to this work attended to the cleaning of the motor houses, any repairs that might be made while the machines were operating and clerical work at the maintenance headquarters. The lamps throughout the factory were cleaned on a schedule. Those in a particularly bad location, such as those for certain woodworking operations, required cleaning once a day, while lamps in other places were scheduled to be cleaned every two weeks. The cleaning of lamps is a subject that does not have the attention that it should receive, with the result that in a great many factories the lighting system is operated at very low efficiency. The men employed on this class of work were rated seven-day men as there were numerous lamps that could not be cleaned during the operating period. The men received the pay of laborers.

The engineer or general foreman is notified as soon as any trouble occurs, such as motor shut-down, overheating of apparatus or any other trouble out of the ordinary, so that he may apply himself at once to the case and ascertain the cause of the trouble. By this procedure several cases of trouble showed faults which led to changes throughout the plant and no doubt prevented more shut-downs from the same cause.

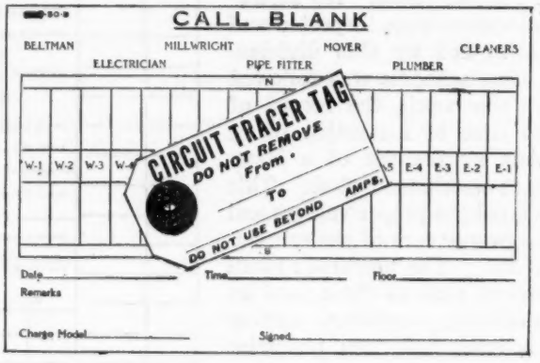


FIG. 4—CALL BLANK FOR EMERGENCY REPAIR AND TAG FOR TRACING AND FUSING CIRCUITS

The different forms shown which are used in making the various reports are mostly self-explanatory. On the back of these sheets may be reported any other important circumstances. The sheet for the electric truck report is ruled on the reverse side to allow the repair man to record in detail the time spent on certain repairs. The careful reading of these reports by the general foreman should call to his attention a defect often repeated and should result in the investigation of the cause and the possible remedy of the defect. The circuit tracer tag shown is required to be attached to all circuits other than the standard main lines and has proved a great help to the maintenance man in quickly replacing fuses and tracing wires. It also prevents any guess work as to the proper fuse to install. In each transformer house are mounted prints showing the entire high-tension system from the power-house switchboard to the transformer houses. At the maintenance headquarters records are kept of the location of every piece of electrical apparatus with the name-plate rating or any other descriptive matter that would help in identification or in ordering new parts.

The trouble notice shown was developed for the use of the electrical and mechanical departments and has proved of value. For example, a motor on the fifth floor of one of the buildings drops out at frequent intervals, resulting in a falling back in the schedule of work to be turned out by that department. The foreman calls the telephone to which all troubles are reported and informs the person answering of the trouble that the motor is causing. The person receiving the message fills in the time of receiving the message, location of trouble, nature of trouble, name of the person complaining and then signs the slip. This has been made out in duplicate, the duplicate being kept on file in the office until the complaint has been attended to, and the original is at once given to the man whose duty it is to attend to such a complaint. This man finds on arriving that the motor is overheated and at once gets in touch with the test man, who brings an ammeter and gets in on the circuit and finds out the extent of the overload. The motor maintenance man proceeds to set the relays high enough to allow the motor to operate, if in his opinion the motor can stand the load until it may be shut down conveniently, so as not to interfere with the production. The engineer has been notified of the trouble and upon investigating discovers that a group of grinders are using incorrect wheels for the job, with the result that more power is required for the work. The cause of the motor falling out at intervals was that the machines got into step and all peak loads came at the same time. If the correct wheels are not in stock but will be in within a few days, and, by the use of fans, it is thought safe to operate with these wheels, permission is given to go ahead; but if the overload is too great, then another motor must be installed temporarily or else some of the grinders must be shut down. The report under the heading of "repair report" is filled out, stating the trouble found and that it had been referred to the engineer. The original copy is now filed with the duplicate copy. The "call blank" is also helpful and is used in conjunction with the trouble report. These are filled out by the person where the trouble occurs, the location of the apparatus in need of the repair being indicated by a cross, and placed on the foreman's desk. The man reporting to remedy the trouble obtains this blank from the foreman's desk and proceeds to the machine without having to spend the time to look up the man who entered the complaint.

Determining Frequency of Inspection

The frequency of inspections varies with the class of apparatus, its use, importance, location and certain features of construction.

Motors in operation are checked as to the following condition daily: Bearings and frame temperature, oil level, connections, condition of drive, cleanliness and any excessive vibration. Those located in dirty places such as forge shops are cleaned by use of compressed air every week, while those in better locations are cleaned by this method once a month. At this time the motor is not operating, and the clearance between the bottom of the rotor and the stator frame is tested with the correct air-gap feeler supplied with the motor, which will show the condition of the bearings. If low, they are replaced with new ones, thereby preventing a shutdown due to a low bearing and a consequent loss of production. With a plant that works only one shift a day the period of inspection can be correspondingly increased. Once every two months the compensators are inspected as to the condition of contacts, height of oil and whether all connections are tight. The overload relays are inspected at this time as to the proper setting and as to the proper amount of oil. On the Monday following the above inspection of the compensators and relays the no-voltage-release coils are tested by lifting the relay plunger while holding the handle of the compensator so that it will not shut down the motor. All section circuit breakers are inspected once a month as to the tripping mechanism and the condition of the contacts. The safety switches are inspected once a month, and loose connections and bad contacts that might cause heating are avoided. On the front of each switch cabinet directions are mounted for starting the motor correctly, and also the number of the telephone to be called in case of trouble with the motor or auxiliary apparatus. If this direction sheet becomes illegible, a new one is provided so that no excuse can be had for abusing the apparatus. The electric meters in the power house are checked every four months and less important meters around the plant at less frequent intervals. The watt-hour meters are checked by the means of a rotating standard with due regard for the ratio curves of the instrument transformers used.

Prints are maintained in the electrical headquarters showing the position of all underground conduits to scale. When any excavating is to be done the foreman of the gang doing the work gets in touch with the electrical department and ascertains whether he must be on the watch for conduits. The course of the high-tension duct system, which is partly under the buildings, is painted on the wall both inside and outside of the building to warn other departments which are liable to perform work that might injure the system.

A board has been arranged at the headquarters with a small lamp on it for each elevator, synchronous motor and forge-shop blower installed, the idea being that whenever any one of the machines mentioned is cut in or out of service the man at headquarters shall be notified so that he may turn the corresponding lamp on or off on the board. This enables the general foreman to tell at a glance the condition of the system and what additional service can be given if complaint is received from the factory.

All fuses are of the cartridge type excepting on the main switchboards and the inclosed power panel, where copper link fuses are used, as less room is required for this type of fuse and consequently for the boards. A renewable fuse is used and has proved very satisfactory and a money saver. The shells of the smaller type of fuses such as used on the lighting and small power circuits are painted different colors, as blue for 5 amp., red for 10 amp., yellow for 15 amp., etc., which enables the maintenance men to tell at a glance whether the proper fuse was installed.

The proper maintenance of some branches of factory equipment has not received the attention that it should in the past, but the managements are beginning to realize that it is cheaper to forestall the interruptions than to put up with them, if the former plan can be followed at reasonable expense. Naturally, the inspection and maintenance can be caried too far and become a burden instead of a saving. By a study of the expense incurred a balanced department can be organized the value of which to the plant it will be hard to estimate in money.

The Energy Component in Industry

An Analysis of the Extent to Which Power Enters Into Manufacturing in the United States—Electrification of Industry Is Paralleled by Lower Unit Energy Costs and Increased Absorption of Power

THE three chief physical elements required for the production of any commodity are raw materials, labor and energy, either in the form of heat or of mechanical or electrical power. A commodity may also contain elements of cost required to compensate for directing and designing, to provide a return on the capital invested in plant and equipment, and to yield a profit on the undertaking. The sum of all these elements or components determines the value of the product.

The relation of these various components, one to the other is variable, depending upon the kind of product and the conditions under which it may be produced. A number of plants manufacturing an essentially identical article may show fairly wide variations in the output per operative, in the profit per unit produced and in other similar ratios. A further variation is to be expected also as between various related products of the same industry. We would, for example, expect quite a different relation between the cost of raw material and of labor in the production of fine sheetings and of heavy duck. Finally, wide differences in the relation of these components will be revealed if the main industrial groups are compared, the heavier industries, such as steel and paper, requiring much greater amounts of energy than lighter industries, such as food and leather.

The degree to which energy in any of its varied forms now enters into the production of a raw material or into the manufacture of a finished product measures the extent to which man, through the use of his intelligence, has succeeded in obtaining the assistance of natural forces. If it is possible to devise additional means of performing hand operations mechanically or electrically, there will be brought about a further increase in the use of energy and a corresponding decrease in the requirement of labor. For each unit of labor a larger quantity of energy will then be utilized and the amount of energy entering into the industrial product will have been proportionally increased.

RELATION BETWEEN ENERGY AND OTHER ELEMENTS

The purpose of this article and the charts which accompany it is to show the relation between the quantity and value of energy used and the other elements that go to form industrial products, to compare these relations in particular industries and industrial groups, and to show, in so far as the information available permits, the extent to which the energy used is in the form of electric power. The statistical information relied upon has been obtained from the recently issued report of the Census of Manufactures and relates to production in the calendar year 1914. This investigation of manufacturing is the most comprehensive yet undertaken, and every care was exercised that the results represent accurately and fully the status of the various industries during that year. The census endeavors to reach all factories producing more than $500 worth of products during the year, and about 275,000 plants were actually covered by the investigation, all important industrial establishments being included.

The term "manufacturing" as used by the census defines one of the primary industrial groups, coördinate with agriculture, with mining and with public utilities. The various branches of manufacturing employed in 1914 8,263,000 persons, utilized over 22,000,000 hp. and turned out products valued at over $24,000,000,000. In comparison with the year 1909, in which the previous census had been taken, there was an increase in number of wage earners of 6.4 per cent, while the value of products increased 17.3 per cent.

As the term was used by the census, "primary power" included all power that was primary from the standpoint of the manufacturing establishment using it. The term is given quite a different meaning from that which it receives in engineering, where it is used to distinguish power available at all times from that available only at some periods. The installation of primary power, as shown by the census report, increased about 20.7 per cent during the five-year period, although the advance in the cost of energy was only 17 per cent.

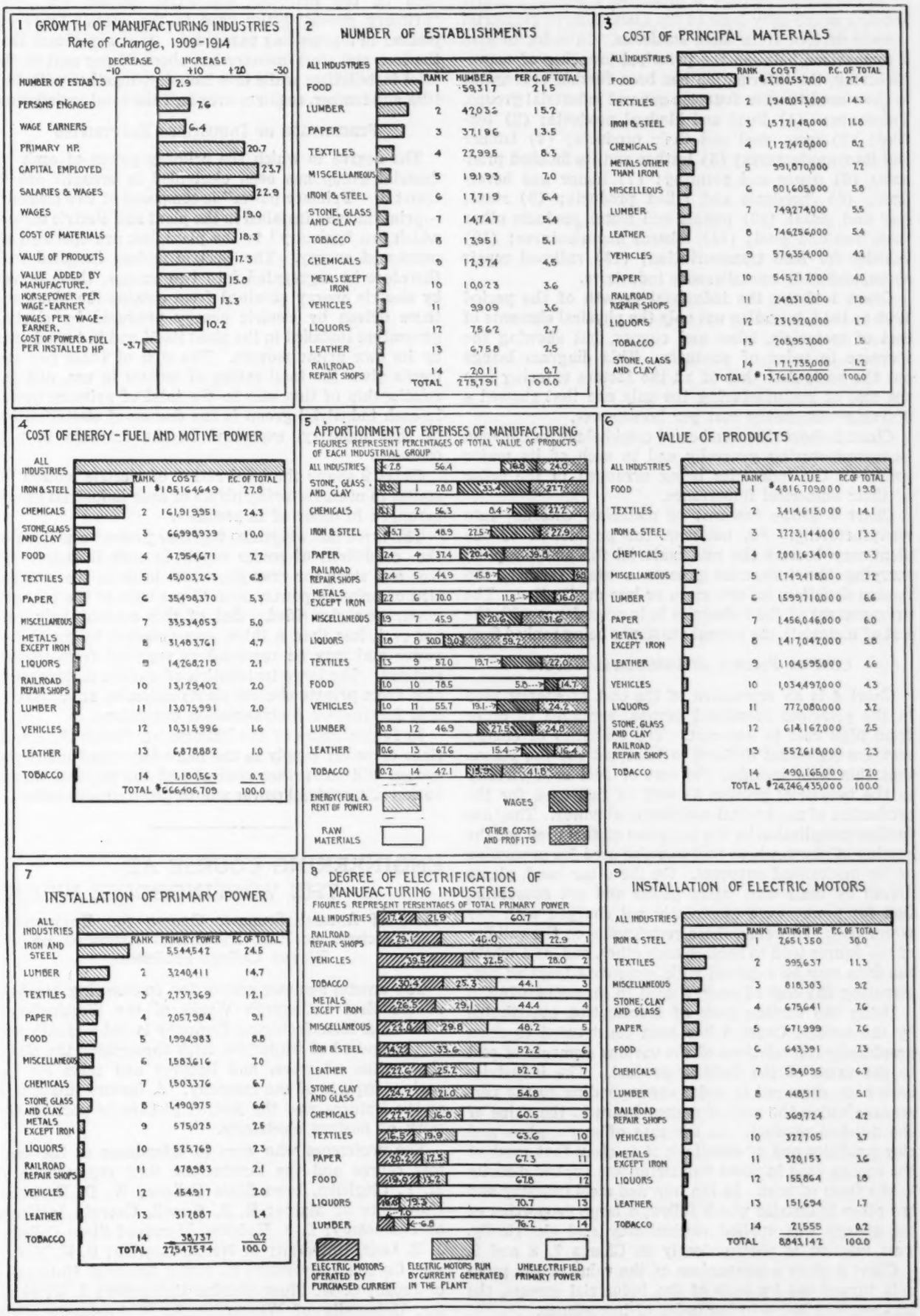
INFORMATION SHOWN BY THE CHARTS

The primary horsepower installed increased during the same period from 2.8 to 3.2 for each wage earner employed. The cost of fuel and power, on the other hand, decreased from $30.60 to $29.50 for each horsepower of primary power installed. The average annual wage for the industries represented increased from $517 to $570. Thus a 20 per cent increase in power equipment was accompanied by a 10 per cent increase in the average wage and by a 3 per cent decrease in the average cost of energy per horsepower.

These figures cover a period of normal industrial development in the United States. In the year 1914 industry was not yet greatly stimulated by the European war, and comparisons with 1909 may therefore be accepted as free from highly abnormal influences. These comparisons are therefore significant of the normal tendencies of the use of power in industry and clearly illustrate the general principles outlined in the first of this discussion.

ELECTRIFICATION OF MANUFACTURING INDUSTRIES

Another comparison may be made to show the degree of electrification of manufacturing industries. In 1909 for 18,675,346 hp. of primary power there was installed 4,817,140 hp. of electric motors, while in 1914 these figures had increased to 22,547,574 hp. and 8,847,622 hp. respectively. Expressing the conditions in another way, in 1909 25.8 per cent of manufacturing power was electrified, while in 1914 the ratio was 39.3 per cent, an increase of 84 per cent in motor installation and of 52 per cent in degree of electrification. Further, in 1909 36.3 per cent of the motors were driven by purchased energy, presumably obtained from central stations, while in 1914 the proportion had increased to 44.2 per cent. This growth of the use of electricity may well explain the decrease in energy cost brought out in a previous paragraph, although the statistics are not sufficiently detailed to establish a direct relationship.


1 GROWTH OF MANUFACTURING INDUSTRIES
Rate of Change, 1909-1914
DECREASE -10 0 INCREASE +10 +20 -30
NUMBER OF ESTABTS 2.9
PERSONS ENGAGED 7.6
WAGE EARNERS 6.4
PRIMARY HP. 20.7
CAPITAL EMPLOYED 23.7
SALARIES & WAGES 22.9
WAGES 19.0
COST OF MATERIALS 18.3
VALUE OF PRODUCTS 17.3
VALUE ADDED BY MANUFACTURE. 15.8
HORSEPOWER PER WAGE-EARNER 13.3
WAGES PER WAGE-EARNER. 10.2
COST OF POWER & FUEL PER INSTALLED HP -3.7
2 NUMBER OF ESTABLISHMENTS
ALL INDUSTRIES
RANK NUMBER PER C. OF TOTAL
FOOD 1 59,317 21.5
LUMBER 2 42,036 15.2
PAPER 3 37,196 13.5
TEXTILES 4 22,995 8.3
MISCELLANEOUS 5 19,193 7.0
IRON & STEEL 6 17,719 6.4
STONE, GLASS AND CLAY 7 14,747 5.4
TOBACCO 8 13,951 5.1
CHEMICALS 9 12,374 4.5
METALS EXCEPT IRON 10 10,023 3.6
VEHICLES 11 9,909 3.6
LIQUORS 12 7,562 2.7
LEATHER 13 6,758 2.5
RAILROAD REPAIR SHOPS 14 2,011 0.7
TOTAL 275,791 100.0
3 COST OF PRINCIPAL MATERIALS
ALL INDUSTRIES
RANK COST P.C. OF TOTAL
FOOD 1 $3,780,557,000 27.4
TEXTILES 2 1,948,053,000 14.3
IRON & STEEL 3 1,572,148,000 11.6
CHEMICALS 4 1,127,428,000 8.2
METALS OTHER THAN IRON 5 991,870,000 7.2
MISCELLEOUS 6 801,605,000 5.8
LUMBER 7 749,274,000 5.5
LEATHER 8 746,256,000 5.4
VEHICLES 9 576,354,000 4.2
PAPER 10 545,217,000 4.0
RAILROAD REPAIR SHOPS 11 248,310,000 1.8
LIQUORS 12 231,920,000 1.7
TOBACCO 13 205,953,000 1.5
STONE, GLASS AND CLAY 14 171,735,000 1.2
TOTAL $13,761,680,000 100.0
4 COST OF ENERGY - FUEL AND MOTIVE POWER
ALL INDUSTRIES
RANK COST P.C. OF TOTAL
IRON & STEEL 1 $185,164,649 27.8
CHEMICALS 2 161,919,951 24.3
STONE, GLASS AND CLAY 3 66,998,939 10.0
FOOD 4 47,954,671 7.2
TEXTILES 5 45,003,243 6.8
PAPER 6 35,498,370 5.3
MISCELLANEOUS 7 33,534,053 5.0
METALS EXCEPT IRON 8 31,483,761 4.7
LIQUORS 9 14,268,218 2.1
RAILROAD REPAIR SHOPS 10 13,129,402 2.0
LUMBER 11 13,075,991 2.0
VEHICLES 12 10,315,996 1.6
LEATHER 13 6,878,882 1.0
TOBACCO 14 1,180,563 0.2
TOTAL $666,406,709 100.0
5 APPORTIONMENT OF EXPENSES OF MANUFACTURING
FIGURES REPRESENT PERCENTAGES OF TOTAL VALUE OF PRODUCTS OF EACH INDUSTRIAL GROUP
ALL INDUSTRIES 2.8 56.4 16.8 24.0
STONE, GLASS AND CLAY 3.9 1 28.0 33.4 27.7
CHEMICALS 8.3 2 56.3 0.4 27.2
IRON & STEEL 5.7 3 48.9 27.5 27.9
PAPER 2.4 4 37.4 20.4 39.8
RAILROAD REPAIR SHOPS 2.4 5 44.9 45.8 7.0
METALS EXCEPT IRON 2.2 6 70.0 11.8 16.0
MISCELLANEOUS 1.9 7 45.9 20.6 31.6
LIQUORS 1.6 8 30.0 9.0 58.7
TEXTILES 1.3 9 57.0 19.7 22.0
FOOD 1.0 10 78.5 5.8 14.7
VEHICLES 1.0 11 55.7 19.1 24.2
LUMBER 0.8 12 46.9 27.5 24.8
LEATHER 0.6 13 67.6 15.4 16.4
TOBACCO 0.2 14 42.1 15.9 41.8
ENERGY (FUEL & RENT OF POWER)
WAGES
RAW MATERIALS
OTHER COSTS AND PROFITS
6 VALUE OF PRODUCTS
ALL INDUSTRIES
RANK VALUE P.C. OF TOTAL
FOOD 1 $4,816,709,000 19.8
TEXTILES 2 3,414,615,000 14.1
IRON & STEEL 3 3,223,144,000 13.3
CHEMICALS 4 2,001,634,000 8.3
MISCELLANEOUS 5 1,749,418,000 7.2
LUMBER 6 1,599,710,000 6.6
PAPER 7 1,456,046,000 6.0
METALS EXCEPT IRON 8 1,417,042,000 5.8
LEATHER 9 1,104,595,000 4.6
VEHICLES 10 1,034,497,000 4.3
LIQUORS 11 772,080,000 3.2
STONE, GLASS AND CLAY 12 614,167,000 2.5
RAILROAD REPAIR SHOPS 13 557,618,000 2.3
TOBACCO 14 490,165,000 2.0
TOTAL $24,246,435,000 100.0
7 INSTALLATION OF PRIMARY POWER
ALL INDUSTRIES
RANK PRIMARY POWER P.C. OF TOTAL
IRON AND STEEL 1 5,544,542 24.5
LUMBER 2 3,240,411 14.7
TEXTILES 3 2,737,369 12.1
PAPER 4 2,057,984 9.1
FOOD 5 1,994,983 8.8
MISCELLANEOUS 6 1,583,616 7.0
CHEMICALS 7 1,503,376 6.7
STONE, GLASS AND CLAY. 8 1,490,975 6.6
METALS EXCEPT IRON 9 575,025 2.5
LIQUORS 10 525,769 2.3
RAILROAD REPAIR SHOPS 11 478,983 2.1
VEHICLES 12 454,917 2.0
LEATHER 13 317,887 1.4
TOBACCO 14 38,737 0.2
TOTAL 22,547,574 100.0
8 DEGREE OF ELECTRIFICATION OF MANUFACTURING INDUSTRIES
FIGURES REPRESENT PERSENTAGES OF TOTAL PRIMARY POWER
ALL INDUSTRIES 17.4 21.9 60.7
RAILROAD REPAIR SHOPS 29.1 48.0 22.9 1
VEHICLES 39.5 32.5 28.0 2
TOBACCO 30.4 25.3 44.1 3
METALS EXCEPT IRON 26.5 29.1 44.4 4
MISCELLANEOUS 22.0 29.8 48.2 5
IRON & STEEL 14.2 33.6 52.2 6
LEATHER 27.6 25.2 52.2 7
STONE, CLAY AND GLASS 24.2 21.0 54.8 8
CHEMICALS 22.7 16.8 60.5 9
TEXTILES 16.5 19.9 63.6 10
PAPER 20.1 12.5 67.3 11
FOOD 19.6 12.6 67.8 12
LIQUORS 16.8 12.5 70.7 13
LUMBER 1.0 6.8 76.2 14
ELECTRIC MOTORS OPERATED BY PURCHASED CURRENT
ELECTRIC MOTORS RUN BY CURRENT GENERATED IN THE PLANT
UNELECTRIFIED PRIMARY POWER
9 INSTALLATION OF ELECTRIC MOTORS
ALL INDUSTRIES
RANK RATING IN HP P.C. OF TOTAL
IRON & STEEL 1 2,651,350 30.0
TEXTILES 2 995,637 11.3
MISCELLANEOUS 3 818,303 9.2
STONE, CLAY AND GLASS 4 675,641 7.6
PAPER 5 671,999 7.6
FOOD 6 643,391 7.3
CHEMICALS 7 594,095 6.7
LUMBER 8 448,511 5.1
RAILROAD REPAIR SHOPS 9 369,724 4.2
VEHICLES 10 327,705 3.7
METALS EXCEPT IRON 11 320,153 3.6
LIQUORS 12 155,864 1.8
LEATHER 13 151,694 1.7
TOBACCO 14 21,555 0.2
TOTAL 8,843,142 100.0

MANUFACTURING IN ITS RELATION TO POWER

On the preceding page is presented a series of charts showing graphically some of the basic facts of industrial growth derived from these statistics. In order to give a comparison between the principal branches of manufacturing, the information has been further segregated to show conditions in fourteen general industrial groups. These are: (1) Food and kindred products; (2) textiles; (3) iron, steel and their products; (4) lumber and its manufactures; (5) leather and its finished products; (6) paper and printing; (7) liquor and beverages; (8) chemicals and allied products; (9) stone, clay and glass; (10) metals and metal products other than iron and steel; (11) tobacco manufactures; (12) vehicles for land transportation; (13) railroad repair shops, and (14) miscellaneous industries.

Chart 1 shows the industrial growth of the period 1909 to 1914, including not only the physical elements of cost of materials, labor and energy, but showing the increase in value of products. This diagram brings out the basic fact that of all the factors entering into the cost of manufacturing the only one that showed a decrease was energy cost per horsepower.

Chart 2 shows the number of establishments engaged in manufacturing generally and in each of its major branches, the industries being arranged in the order of their numerical importance.

Chart 3 shows the cost of materials entering into manufacturing. As, however, the production of one plant may become the raw material for another plant carrying the industrial process a step farther, the figures doubtless include more or less duplication. The arrangement of the industries is in accordance with the cost of materials, the largest consumer being ranked first.

Cost of Energy in Industrial Groups

Chart 4 is an expression of the cost of energy used in the principal industrial groups, arranged in order from high cost to low cost. The statistics of energy cost are somewhat difficult to interpret for the reason that this item included the cost of fuel used directly in the industrial process as well as fuel used for the production of mechanical and electrical power. They are further complicated by the inclusion of fuel used for the heating of plants where fuel was also used for processing or for mechanical purposes. On the other hand, plants driven by their own water power and not consuming fuel for power were apparently not charged with any power cost. However, these restrictions on the validity of the figures tend to balance each other, and, as a whole, the data may be received with some confidence as representing the cost of energy used in manufacturing.

Using the various lines of information contributed by the census, Chart 5 has been constructed to show graphically the relations of the various elements of cost to the value of the finished product. The industries have been arranged in order corresponding to the percentage which the cost of energy bears to the value of the finished product. In the case of stone, glass and clay products and of chemicals it is clear that most of the energy used in these industries was applied directly in the form of heat. In the iron and steel industry and the other industries which follow, a large proportion of the energy was applied mechanically and electrically. This relation is shown clearly in Charts 7, 8 and 9.

Chart 6 gives a comparison of the value of the products turned out by each of the industrial groups, the arrangement being in the order of importance.

Chart 7 shows the primary power used in 1914 in each of the principal industrial groups, the term "primary power" being used in the special sense explained in a preceding paragraph. It is significant that the iron and steel industry has about 25 per cent of the total installation, while this industry, together with textiles and lumber, requires over half the total installation.

Percentage of Industries Electrified

The degree to which the primary power of each industrial group has been electrified is brought out in Chart 8. "Primary power" is composed of two elements —prime movers installed in the plant and electric motors which are "primary" to the plant but are operated by purchased energy. The electric motors installed may therefore be segregated into two groups, those driven by electric energy obtained from outside the plant and those driven by electric energy produced by electric generators installed in the plant itself and in turn driven by its own prime movers. The sum of these two elements gives the total rating of motors in use, and the relationship of this sum to the total of primary power in each industrial group is the degree of electrification of that industry, expressed in the diagram in percentages.

Chart 9 shows the total rating of electric motors installed in manufacturing plants of each industrial group, arranged in order of importance.

The three last diagrams together present a picture of the conditions of power supply in each industry. In iron and steel, for example, which leads in the installation of primary power, over 45 per cent of the primary power was electrified. But of this amount only 14.2 per cent, less than a third, was operated by purchased power and may be regarded as supplied from central stations. The large installation of electric motors operated from private electric plants indicates an attractive field for further central-station extensions.

In future issues of the Electrical World the conditions of power supply in the more important industrial groups will be further studied and the regional distribution of industrial power will be given consideration.

ENGINEERING COURSE AT THE WESTINGHOUSE WORKS

Close of Annual Summer Course for Engineering Teachers at East Pittsburgh Attended by Eleven College Professors

The annual summer course for engineering teachers at the East Pittsburgh Works of the Westinghouse Electric & Manufacturing Company lasted a month and was composed of inspection trips throughout the plant, observation of work, and lectures and talks by the various experts of the company. A feature introduced at the lectures was the motion picture to portray the work of modern electricity.

The professors who were in attendance at the summer course and the institutions they represent are: M. P. Cleghorn, Iowa State College; W. D. Emerson, University of Maine; R. S. Howell, Georgia Institute of Technology; L. J. Hodgins, Maryland State College; J. E. Lear, University of North Carolina; B. K. Northrop, Cornell University; S. Noda, Imperial University of Japan; C. W. Piper, Purdue University; J. W. Shuster, University of Wisconsin; A. F. Puchstein, Ohio State University, and E. B. Wood, Pratt Institute.

Shooting Trouble in Alternating-Current Motors

Practical Methods of Locating, Remedying and Preventing the Recurrence of Some Common Electrical and Mechanical Faults Which Develop in the Course of Operating Polyphase Induction Motors

POLYPHASE-MOTOR troubles can be diagnosed in much the same manner as a physician diagnoses human ailments. Any one who has any information bearing on the case should be questioned and the information so obtained should be checked up with whatever visible evidence is available, with the troubleman's previous experience in such matters and by actual test when deemed necessary.

It is good practice, even when the trouble has been found by inspection or deduction, to determine by testing early in the investigation whether there is electric service up to the motor fuses. The next thing is to test all the fuses to see which, if any, have been blown. In addition to overload on the motor, many other things cause fuses to blow. Among them are the following:

1. Operator throwing starting switch or compensators from starting to running position too quickly.
2. Operator throwing switch into running position without touching the starting position at all.
3. Motor winding becoming grounded.
4. Excessive current due to low voltage, short-cuits in stator windings, single-phase operation, etc.
5. Starting switch being in running position when service comes back on line after interruption.

Wound-rotor motors and squirrel-cage motors which are not protected by a no-voltage release may be shut down at any time because of the last-mentioned cause. To overcome this trouble a group of such motors is often protected by an oil switch equipped with no-voltage release. The arrangement has the disadvantage, however, that whenever the oil switch opens it becomes necessary for some one to go around and open each individual motor switch before the oil switch is closed again.

A ground may only blow one fuse and leave the motor operating from one phase of the line. When a polyphase motor is running single-phase it not only gets hot but it makes a growling noise which is especially noticeable under heavy load. By the time these symptoms indicate the probable source of the trouble and it is decided to shut down the motor a second fuse is sometimes blown by the excessive current per phase. If only the first defective fuse found is replaced, the motor may be started from the line side of the switch which is connected ahead of the fuses. When the switch is thrown over into the running position the motor is again operating on single phase. Because the motor continues to heat up the user often thinks there must be something wrong with the motor itself and calls for help, whereas if he had only tested all the fuses in the first place and replaced all of the burnt-out fuses instead of only one of them, he could have put the motor back in service without assistance and with a minimum loss of time.

Another source of trouble which may be detected at the service fuses is low voltage. This causes excessive heating and often burns out stator coils. The voltage can be checked roughly with test lamps and by the starting torque of the motor if it is operative. When the voltage is equally low on all phases it may be due to excessive voltage drop between the motor and the source of supply or it may be occasioned by an overloaded primary. However, when the voltage is not equal on all phases and the normal potential of 220 is only shown on two phases and it drops to about 180 volts on the other phase, a fuse may have blown on the primary side of the transformers.

From the fuses it is customary to proceed to examine the motor-starting switch, compensator or controller. Contact fingers are often found bent or burned so that they do not make contact and the connecting leads are sometimes burned off. The two-minute starting resistance supplied by the manufacturers for starting slip-ring motors is often burned out by being used for speed-regulating duty which requires a much heaver resistance.

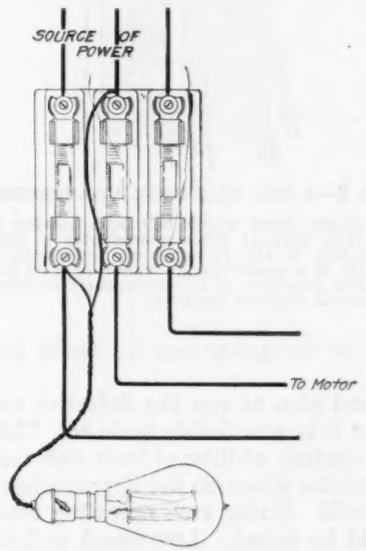


FIG. 1—TESTING FUSES ON THREE-PHASE LINE

When the test lamp shows that service is on the line each fuse can then be tested by connecting the lamp from the load side of the fuse to the line side of an adjacent phase as shown. If the lamp does not light, the fuse should be renewed.

Coming now to the motor proper, it is customary to test it for grounds. A magneto or high-voltage testing transformer should be used for this purpose, as the line voltage will seldom show a ground unless it is making very good contact. National Electrical Code rules require that motor frames be grounded, but this requirement is not always carried out. When the motor frame is insulated from the ground the motor can be kept in operation with one phase grounded to the motor frame, but the defect should be remedied at the first opportunity. A second connection between the stationary windings and the motor frame will burn out the coils which it short-circuits, and if not given prompt attention the two grounds may result in the burning out of the entire winding. When both the supply system and the motor frames

are grounded, as is usually the case, one ground on the stator winding will blow one of the motor fuses unless the fuse is too heavy, in which case the ground may burn out some of the stator coils. However, every ground which blows a fuse does not occur in the motor winding. If the motors test clear, the wiring leading to the motor may be found grounded to the conduit.

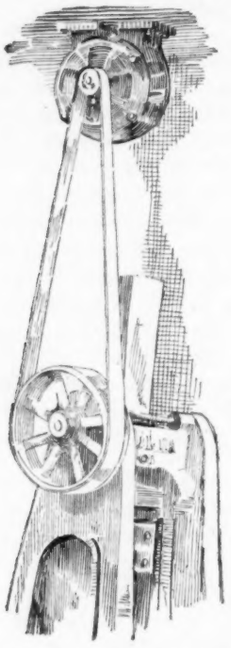


FIG. 2—A POOR BELT DRIVE ARRANGEMENT

This drive is one from which belt and bearing trouble may be expected. The vertical drive necessitates a tight belt, and even then the belt is apt to come off with such large pulley ratios, especially if a squirrel-cage motor is used for starting a heavy load. The insertion of a countershaft between the motor and its load would improve matters.

It is a good plan to run the defective motor while testing when it is practicable to do so. This makes it possible to conduct additional tests and very often to observe symptoms which do not appear when the motor is standing still. Under such operating conditions the speed should be tested. Low speed and inability to pull the load are usually an indication of bad connections between the rotor bars and the rotor end rings. More will be said about this trouble later.

Another condition to observe while the motor is operating is whether the stator coils are hotter in one place than in another. This is one of the signs of bearing trouble. When the bearings become worn the stator coils around the section of reduced air gaps get hotter than the coils adjacent to the section where the air gap has been increased. If the bearings are not renewed before the rotor begins to rub on the stator, the motor windings may be seriously injured, especially if the fuse is too large and does not blow. When it is impracticable to operate the motor the belt should be taken off and the bearings examined to find out if there is too much play in them.

Much belt and bearing trouble is caused by the belt being too tight. This is especially true with vertical belt drives from squirrel-cage motors to high-speed machines. When bearing trouble is experienced with installations of this description it is usually because the pulley surface is too small to accelerate the driven machine as fast as a squirrel-cage motor comes up to speed, and consequently the belt comes off. In attempting to keep the belt on the pulley the belt is usually made so tight that the excessive tension soon wears down the bearings. This trouble can sometimes be overcome in installations of small motors by using larger pulleys, a larger motor, or by changing from a vertical belt drive to a horizontal belt drive with the slack side of the belt on top. With large belted motors driving high-speed machines the slip-ring type of motor should be used in order to bring the driven machine up to speed more slowly.

When these suggestions do not locate the trouble and the windings are thought to be defective, the motor end shields should be removed to permit an examination of the rotor and stator windings. The presence of solder spattered over the stator coils indicates that the connections between the rotor bars and the rotor end rings have become unsoldered. The rotor should then be removed to facilitate resoldering.

A bad contact in the rotor winding is not so easily found when the end rings are cast on to the end of the rotor bars. This cast construction was said to have been adopted to overcome the bad joints which developed with screwed and soldered connections in the rotor windings. The change has not entirely eliminated the trouble, however, because the molten metal does not always unite with the end of the copper bars when the end rings are being cast. When this is the case trouble due to the poor contact often develops, especially if the motor is subject to much dirt and vibration. With a little experience a defective joint between the cast end rings and the rotor bars can be found by tapping the end rings with a hammer and noting the difference in sound at various places. A bad joint in this type of construction can be repaired by welding the bar and end rings together. Welded rotor windings have been very successful, and it is unusual to find bad joints in rotor windings which have been put together in this manner.

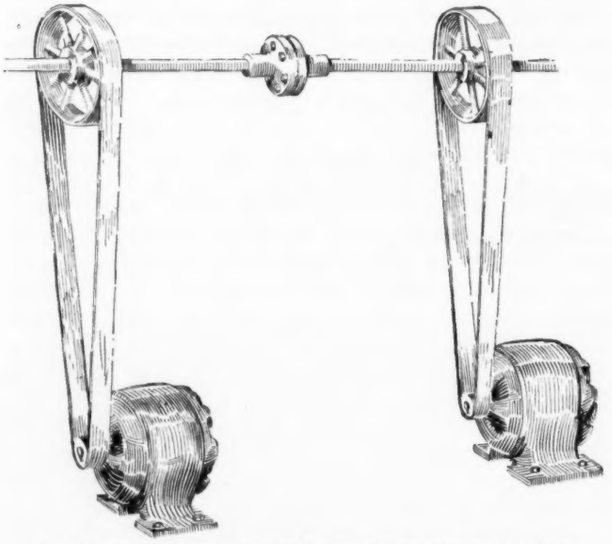


FIG. 3—TWO MOTORS SHOULD NOT DRIVE THE SAME LOAD OR A LINE SHAFT

The stator winding should also be thoroughly examined while the end shields are off the motor. If one or two coils are burned out, the other coils can in most instances be raised out of the slot and new coils slipped into place provided that the coil insula-

tion is flexible and in good condition. Should this be attempted, however, after the insulation on the coils has become brittle, there is a grave danger of damaging the insulation to such an extent that the entire stator winding may have to be renewed. When the condition of the insulation is doubtful and only one or two coils need replacing, it has been found a good plan to cut away the burnt-out coils and thread new wire through the slots turn by turn, without disturbing any of the other coils.

The damage from a local short circuit in the stator winding can be limited to the one or two coils affected and the motor still kept temporarily in service by promptly cutting out the damaged coil with a jumper. However, if the trouble is neglected it will spread to other coils in the same phase, and then the windings of the other phase or phases will also burn out.

Sparking at the slip rings of wound-rotor motors occurs when the tension spring has not been reset from time to time to keep the brushes in close contact with the slip rings. This is the most frequent cause of the trouble, and it can usually be eliminated by adjusting the tension of the spring and where necessary turning up the slip rings and renewing the brushes.

An arrangement which almost invariably causes trouble is to belt two motors to one line shaft. If both motors are not of the same size, the smaller one usually takes more than its share of the load and

FIG. 4—A GOOD BELT DRIVE ARRANGEMENT

The belt should be nearly horizontal with the slack side of the belt on top as shown. This condition is governed by the direction of rotation and the relative position of the driving and driven pulleys.

either blows the fuses or burns out the motor windings. Even when both motors are supposed to be identical, there is in nearly every case some difference in the actual speed of the two motors. This results in an unequal division of the load and the fuses of one motor may blow repeatedly. This annoyance can be overcome by breaking the mechanical connection between the two motors and giving each one its independent load or by installing one motor large enough to do the work of the two motors.

A hot motor is not always the result of abnormal conditions. A notable instance may be found in the 50-deg. maximum rated motors which are designed to operate at a much higher temperature than that to which users have been accustomed. Many users think that 50-deg. motors are in danger of burning out until the operator has been made to understand that the motor manufacturer did not expect any one to be able to hold his hand on the frame of the motor even when it is operating under normal full-load conditions.

The information for this article was furnished by Henry W. Zeuner, of the Milwaukee Electric Light Company, and is based on his personal experience with many different makes of motors belonging to his company and to its customers.

ALTERNATING-CURRENT ARC WELDER TESTED DURING WAR

Good Welds Produced Without Appreciable Voltage Drop—Investment, Operating and Maintenance Costs Low

RESULTS of tests made at Hog Island shipyard seem to show that alternating-current arc-welding creates only a negligible drop in line voltage. The tests were conducted on a 5-kw., 440-volt primary, single-phase, 60-cycle, 150-amp. secondary, type W welding transformer made by the Electric Arc Cutting & Welding Company of Newark, N. J. Furthermore, the welds made with this alternating-current arc did not seem to differ materially from those made with direct-current apparatus when experienced welders did the work in each case.

The alternating-current apparatus consisted essentially of a core-type transformer with taps on the primary winding to adapt it for use with voltages of 400, 420 or 440. There were also seven secondary terminals giving various voltages. These secondary terminals were marked in accordance with the size and material of the electrode to be used.

TESTS ON 5-KW. ALTERNATING-CURRENT WELDER

		Primary					Secondary	
Sec. Plugs Used	Flux Diverter	Volts	Amp.	Kw.	Kva.	Per Cent Power Factor	Open-Circuit Volts	Condition
...	....	471	1.10	0.182	0.518	35.1	....	No load
1–7	Out	443	39.2	6.00	17.4	34.5	98.3	Welding
1–7	Out	473	39.0	2.32	18.5	12.6	....	Shorted
1–7	Out	473	39.4	2.13	18.7	15.3	....	Shorted
1–7	⅛ in.	444	28.4	4.00	12.6	31.8	96.8	Welding
2–7	Out	447	28.0	6.08	12.5	48.6	95.0	Welding
3–7	Out	445	27.5	5.48	12.2	45.0	92.3	Welding
3–7	¼ in	445	26.0	5.84	11.6	50.5	....	Welding
3–7	⅛ in	445	33.1	1.76	14.7	12.0	....	Shorted
3–7	⅛ in	447	23.9	4.75	10.7	44.5	91.8	Welding
3–7	⅛ in	450	31.7	1.65	14.3	11.6	....	Shorted
4–7	Out	475	22.8	5.65	10.8	52.1	83.7	Welding
4–7	¼ in	475	22.8	5.04	10.8	46.5	83.0	Welding
2–6	Out	448	25.8	5.36	11.6	46.3	....	Welding
2–6	⅛ in	...	....	....	....	....	101.0	Welding
4–6	Out	475	22.6	4.80	10.7	44.7	89.0	Welding
1–5	Out	475	33.8	1.89	16.1	11.8	....	Shorted
1–5	⅛ in	475	29.2	1.60	13.9	11.5	....	Shorted
2–5	⅛ in	444	16.7	3.12	7.4	42.1	103.0	Welding
3–5	Out	448	24.2	4.72	10.9	43.5	102.0	Welding
3–5	⅛ in	447	17.2	2.88	7.7	37.4	101.0	Welding
3–5	⅛ in	448	21.0	0.88	9.4	9.4	....	Shorted
4–5	⅛ in	475	22.0	3.96	10.5	38.0	92.6	Welding

Tests taken on the secondary side of the transformer after the completion of the primary test showed the secondary current to be roughly four times the value of the primary current. The open-circuit secondary potential, which ranged from 83 volts to 103 volts, fell off to from 17 volts to 43 volts while welding was in progress. The exact voltage at the arc could only be estimated, however, as the voltmeter was not calibrated for these low values. The power fluctuated about 10 per cent and the current fluctuated about 25 per cent above and below the test values given.

The welding done during the test consisted in depositing metal on a flat ½-in. (13-mm.) mild-steel plate from a bare 5/32-in. (4-mm.) mild-steel electrode. The kilowatt-hours per pound of metal deposited was not determined at this time, but from other tests the energy required to deposit one pound of mild steel was found to be from 1.5 kw.-hr. to 2.25 kw.-hr. This type of welder was found to be particularly suited for light work in small shops where the expense of a motor-generator set was not warranted and in larger shops where some degree of portability was necessary.

STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

DETROIT PRODUCTION COSTS AT CONNORS CREEK STATION

Station Labor Costs Have Increased 44 per Cent and Fuel Costs 150 per Cent During Past Three Years

The accompanying table shows production costs per kilowatt-hour of output for the Connors Creek station of the Detroit Edison Company, compiled on the basis of twelve-month periods ended June and December of the years 1916 to 1919. It is pointed out by an official of the company that the station has been much increased in size since June 30, 1916, and additional apparatus has been placed in operation. There have also been marked changes in the quality of coal burned, so that it is unwise to draw comparisons between the various figures of the table too closely. However, it is interesting to note that the output has increased during the last three years from 125,158,800 kw.-hr. to 393,252,000 kw.-hr., or 200 per cent.

TABLE I—PRODUCTION COSTS FOR TWELVE MONTHS ENDED JUNE 30, 1919

	Total Expense	Expense per Kw.-Hr.
Operation:		
Superintendence	$39 097.91	$0.010
Wages	237,683.52	.062
Fuel	1,510,582.83	.394
Water	.....	.....
Lubricants	8,762.37	.002
Station supplies and expense	37,097.29	.010
Maintenance:		
Station buildings	31,125.84	.008
Steam equipment	93,711.76	.024
Electrical equipment	4,731.79	.001
Total	$1,962,793.31	$0.511

The increase in fuel and labor costs is shown in a gradually increasing scale from 0.043 cent per kilowatt-hour for station wages in June, 1916, to 0.062 cent per kilowatt-hour for June, 1919, or an increase of about 44 per cent, with an increase in cost of fuel per kilowatt-hour for the same period of about 150 per cent. There is also a noticeable increase in the cost of "station supplies and expense" of approximately 50 per cent during the last year and a half. Although this is a relatively small item expressed in cents per kilowatt-hour, the 100 per cent increase approximates $19,000 for the Connors Creek station, while the 150 per cent increase in fuel cost per kilowatt-hour is on the order of $900,000 a year. These figures are ample evidence of the enormous increases in operating expenses which central-station companies have been forced to carry during the period of the war with no material increase in the price of the product which they sell and with the same or an improved quality of service as during normal or pre-war times.

ECONOMY ARISING FROM SAFE OVERLOADS ON GENERATORS

Conditions Under Which It Is Good Practice to Operate Waterwheel Generators to the Limit of Their Rating

While Mr. Meredith's objections to overloading generators (ELECTRICAL WORLD, Aug. 16, page 358) may usually hold good, there are times when it is a paying proposition to carry substantial overloads continuously. The writer recalls a case where a 500-kw. direct-current waterwheel-driven generator was installed to run in parallel with a number of other generators and rotary converters. The energy was used for electrolytic purposes, and the machines were required to run twenty-four hours a day seven days in the week, being shut down

TABLE II—PRODUCTION COSTS (1916-1919) PER KILOWATT-HOUR OUTPUT AT CONNORS CREEK STATION

	For Twelve-Month Periods Ended—						
	June 30, 1916	Dec. 31, 1916	June 30, 1917	Dec. 31, 1917	June 30, 1918	Dec. 31, 1918	June 30, 1919
Operation:							
Superintendence	$0.013	$0.013	$0.010	$0.010	$0.009	0.009	$0.010
Wages	.043	.042	.047	.050	.055	.061	.062
Fuel	.158	.174	.240	.325	.368	.382	.394
Water	.....	.....	.....	.....	.....	.....	.....
Lubricants	.001	.001	.001	.001	.001	.001	.002
Station supplies and expense	.005	.006	.005	.005	.006	.009	.010
Maintenance:							
Station buildings	.006	.007	.011	.010	.008	.007	.008
Steam equipment	.019	.016	.019	.024	.025	.023	.024
Electrical equipment	.003	.003	.001	.001	.002	.001	.001
Total	$0.248	$0.262	$0.334	$0.426	$0.474	$0.493	$0.511
Kw.-hr. output—net	125,158,800	162,117,600	210,039,700	249,192,200	280,814,700	327,020,500	383,252,000
Maximum demand (30 minutes)	35,000	36,000	50,000	58,000	59,000	80,000	82,000
Average load, kw.	14,300	18,500	23,900	28,400	32,100	37,300	43,700
Load factor	0 409	0.514	0.478	0.489	0 544	0 456	0.533
Coal per kw.-hr.—pounds	1.44	1.45	1.52	1.61	1.63	1.63	1.67
B.t.u. per kw.-hr.	19,700	19,800	20,040	20,470	20,950	20,900	21,200

only when in need of repair. When a machine was down a spare rotary converter was started. The power for the rotaries was generated by steam.

It was found that the waterwheel on the new machine had greater capacity than was expected and that at full gate the generator would have at least 100 kw. overload. The operating temperature was in excess of that recommended by the manufacturer, but the machine commutated well and it was decided to run at full gate even at the risk of ruining the insulation within a few years. That particular machine has been in operation over five years and will probably last several more. Maintenance costs have been low, not over $100 a year. In that time it has been out of service only when necessary to turn the commutator or adjust the brushes, or when the waterwheel needed attention. If it had been run at its rating, it would have generated approximately 3300 hp.-years, but, running at 20 per cent overload, it produced about 4000 hp.-years, a gain of 700 hp.-years which otherwise would have been obtained from rotary converters getting their power from steam-driven generators. It costs $25 a horsepower-year to produce power by water against $100 by steam, a difference of $75. Therefore the gain of 700 hp.-years represents a saving of $52,500. The machine could be shut down now for a year and still have a better financial standing than if it had run at its rating. RALPH MCKINNEY.

Berlin, N. H.

SERIAL NUMBERING AND LETTERING FOR METERS

Indicate Ampere and Voltage Rating of Meter, Type of Instrument and Company Number—Marking Is Stenciled in ¾-In. Characters

A system of numbering and indicating the rating and type of meter is employed by the Choctaw Power & Light Company, McAlester, Okla., which, while similar to systems already used by other companies, differs in a few essential details. Letters and figures stenciled in white are used, their position indicating whether they stand for the current, voltage, type or company number. The markings for all direct-current meters are preceded by the letter O, this being considered sufficient because the few that are installed are rapidly being replaced by instruments of the alternating-current type.

Symbols indicating the current, voltage, type (which also indicates make) and company number are placed in the order named so they will not be confused with the company number which follows. The current rating is indicated by the following letters.

Ampere rating—	5	10	15	20	25	30	40	50	60
Designating letter—	A	B	C	D	E	F	G	H	I
Ampere rating—	75	80	100	150	200	250	300	400	500
Designating letter—	J	K	L	M	N	P	Q	R	S

The voltage is indicated next as follows:

Voltage of meter—	110	220	440	550	2300 and higher
Designating figure—	1	2	4	5	X

Next comes the type of meter, which is indicated by letter:

	Make of Meter								
	General Electric					Westinghouse			Sangamo
Type—	I	I-10	I-14	D-3	D-6	B	C	OA	H
Designating letter	I	U	T	Y	D	B	C	A	H

It is not necessary to designate the make because the type identifies that.

Kind of Meter	Serial Number
5-amp., 550-volt type C (d.c.) G.E., company number 678	O A 5 C 6 7 8
5-amp., 110-volt, type I, G.E., serial number 678	A 1 I 6 7 8
10-amp., 110-volt, type O A, Westinghouse, serial number 678	B 1 A 6 7 8
50-amp., 440-volt, type D 6, G.E., serial number 678	H 4 D 6 7 8
100-amp., 2300-volt, type D 3, G.E., serial number 678	L X Y 678

This information is sufficient to indicate the register ratio, dial multiplier and disk constant.

It is the practice of the Choctaw company to use 5-amp., 110-volt polyphase meters with all power installations so that the constants and disk multipliers are determined by taking into consideration the instrument transformers used with the meter. To indicate that this must be done the letter T is appended to the serial number of each power meter. For example, in a 60-amp., 440-volt installation the company might use a 5-amp., 110-volt D-6 meter with transformers, which would be numbered A 1 D 678 T.

In the case of some meters, like the D-6 General Electric type, where there is not room for placing all the letters and figures of the serial marking in a single row, the company's serial number is placed below. For example the preceding meter would be marked $\frac{\text{A 1 D}}{\text{678 T}}$.

The letters and figures are placed on the meter covers with ¾-in. (19-mm.) Eureka stencils, a stenciling brush and white lead. This is much less expensive than using metal tags or strips that are fastened on the meters with brads and screws. Furthermore, the marking can be seen much further and can be changed to suit local conditions. It is especially desirable where the company owns only a few thousand meters. P. W. CORDELL,

Superintendent of Meter Department.

McAlester, Okla.

HOW ONE EXCITER WAS USED FOR TWO GENERATORS

Portable Wires Laid on Floor for Temporary Repair—Shunt Field Reversed to Prevent Voltage Drop When Load Was Applied

In an engine room where a 75-kw. and a 50-kw. alternator were driven by separate engines one coil of the exciter of the larger machine became damaged, and of course the load on the generator suddenly went to zero. An immediate replacement of the generator on the line was necessary in the manufacturing process. No time could be lost in making repairs and no spare armature was available. To make the repairs as quickly as possible portable leads were run from the undamaged exciter to the large generator so that the one machine served both generators.

After the connections were made and the machine started, the voltage dropped instead of rising when the load increased. The direction of the current in the shunt field therefore had to be changed in order to have it properly compounded. The defective armature was then removed, the coil cut open, bridged over, and the machine returned to duty in the noon hours.

East Berlin, Conn. H. S. RICH.

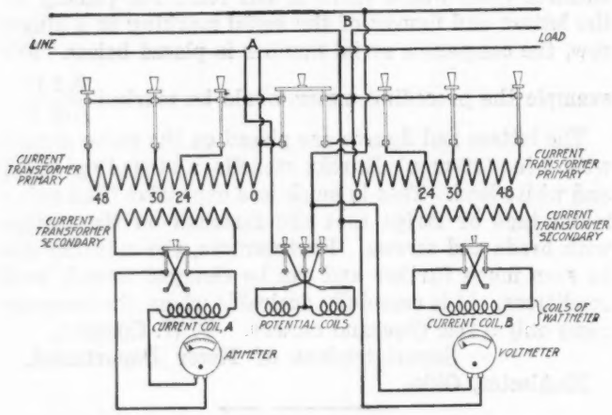
INDUSTRIAL APPLICATIONS

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

PORTABLE OUTFIT FOR THE TESTING OF MOTORS

Current Ratios Readily Afforded by Simple Switching—Arrangements for Reversing Current in Watt-Meter Coils for Checking Purposes

Nearly every industrial plant electrical engineer who recognizes the importance of making periodic tests on performance of apparatus has adopted some form of portable testing apparatus, but the one described here may be found a welcome addition. It is intended for testing three-phase, 440-volt motors rated at 5 hp. to 25 hp. and has proved very satisfactory to the writer. The apparatus and connections employed are indicated in the accompanying illustration.



CONNECTION OF APPARATUS ON PORTABLE MOTOR-TESTING OUTFIT

The current transformers available were Weston Model 313, through which a line wire is passed, forming its primary. The primary in this case was wound with forty-eight turns of double No. 10 wire with taps at twenty-four and thirty turns. Since one turn gives a ratio of 1200 : 5, it follows that forty-eight turns will give 5 : 1, and likewise twenty-four and thirty turns will give ratios of 10 : 1 and 8 : 1 respectively. The ratio 8 : 1, which may seem odd, was chosen for the reason that there were at hand several wattmeter charts graduated to this ratio, thus giving a direct reading on the chart when thirty turns of the primary are employed.

When the outfit is in use only one of the three primary switches for each transformer is closed. As may be seen from the diagram, to obtain a desired ratio it is necessary to close one switch on each transformer, choosing the ones which will include the proper number of primary turns. The secondaries of the transformers are connected to the current coils of the wattmeter through small double-pole, double-throw knife switches, thus enabling the operator to reverse the current in one or both of the coils should this be found necessary when the connections are checked. The wattmeter potential coils are controlled by two single-pole, double-throw switches and one single-pole, single-throw switch, making it possible to reverse the current in these coils or to open the common potential wire in checking. A voltmeter and an ammeter are added to provide a simple method for determining the power factor.

Connections may be conveniently made at *A* and *B* by means of clips fastened to the top and bottom connections of fuses. If the common potential wire is also provided with a clip, it may be connected to the remaining fuse, thus minimizing the work of connecting and disconnecting the set.

The switches and instruments are arranged on the top of a table which is provided with wheels, making it an easy matter to move it from place to place. All switches are back-connected, and the current transformers are placed on a shelf under the table, rendering the top free from connections.

A. H. PLATT.

Bridgeport, Conn.

RECONNECTING A 50-HP. INDUCTION MOTOR FOR 15 HP.

Determining the Possible Reconnection of Stator Winding to Use Large Motor at Best Efficiency at Reduced Rating

During the war a manufacturing establishment required a 15-hp., 220-volt, three-phase, 60-cycle, 580-r.p.m. induction motor for intermittent duty. The speed was an important factor, since the motor was to be direct-connected. The only 580-r.p.m. motor available within reasonable delivery date was a 50-hp., 220-volt, three-phase, 60-cycle design with wound secondary. In order to make use of this motor at best possible efficiency for a load of 15 hp. an investigation was made to see if it could be reconnected for a lower rating and still leave the winding in a condition to be reconnected for the higher horsepower at some future time.

It was found that the stator winding was connected in sir-parallel-star with 36 groups of three coils per group, or a total of 108 coils. The rotor was connected series-star. The problem was to find a connection so that with a line voltage of 220 the output of the motor could be decreased 70 per cent, or, in other words, a connection that would require a line voltage of 374 volts, that is, 220×1.70. A change from six-parallel-star for 220 volts to series-star would require a line voltage of $6 \times 220 = 1320$ volts, or for a series-delta connection the line voltage would have to be $1320 \div \sqrt{3} = 762$ volts approximately. By dividing 1320 by 374 to find the possible series-star connection, the quotient 3.52 was obtained. This eliminated the star connection, as a 3.5 parallel is not practicable and three-parallel-star was out of the question, since it requires 440 volts, or 100 per cent more than 220 volts,

whereas a connection requiring only 70 per cent was required.

For the delta connection, 762 (the series-delta line voltage) divided by 374 gives 1.98, or 2 nearly. A two-parallel-delta connection therefore would require a line voltage of 381 volts, which is only 1.87 per cent more than required. This was considered satisfactory for an intermittent duty and the winding was connected two-parallel-delta. With this connection the motor developed 15 hp. at 220 volts, 52.0 amp. per terminal at 580 r.p.m. The rotor winding was not disturbed.

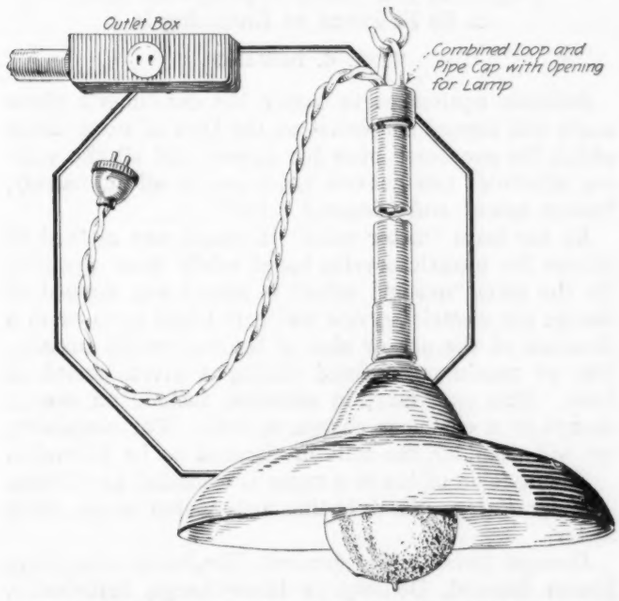
This connection reduced the power consumption, and under the conditions the cost of the larger motor, and reconnecting was the cheapest way out of what seemed at first a very perplexing situation.

New York City. C. A. JOHNSON.

SUSPENSION TYPE OF OVERHEAD LIGHTING FIXTURE

Lamp, Reflector and Pipe Support Hung from Ceiling by Hook—Can Be Moved to Avoid Shafting or Serve as Local Light

The usual form of overhead lighting fixture cannot be readily moved from one position to another; it occasionally conflicts with overhead shafting, machinery, etc., and it does not always give illumination where it is wanted. To avoid these objections one large industrial plant in Connecticut has made its general overhead



SEMI-PERMANENT TYPE OF OVERHEAD LIGHTING FIXTURE WITH PLUG CONNECTION TO CEILING OUTLET

lighting equipment semi-permanent in position. To do this the conduit supplying the lamps has been run in the usual manner to symmetrically placed outlet boxes, but instead of placing the lamps directly under the outlet boxes, they are suspended from hooks placed at any desired distance from the outlet box and connected therewith by twin-conductor cord and a plug connector. The lamps proper are supported several feet from the ceiling. So as to avoid the objectionable features of drop-lamps, each lamp socket and shade is fastened to the end of a ½-in. (1.3-cm.) pipe having at its other end a combined screw cap and loop which may be slipped over a hook in the ceiling for suspending the lamp. From the lamp the conductor runs concealed through the pipe to the cap, where a hole is provided through which it emerges and connects with the outlet box. Thus the lamp cord is protected from mechanical injury, does not support the lamp and is practically all concealed except for the short loop between the cap and outlet box.

The construction described has permitted rearrangement of lighting units to suit changed positions of machines and has also facilitated providing localized lighting at machines where intensity higher than general was required. This was done by disconnecting the lamp cords at the outlet boxes and substituting fixtures with longer pipe hangers.

SAVING AN AUXILIARY BLOWER INSTALLATION

Emergency Air Supplied for Heat-Treating Department Secured from Foundry Installation at Minimum Cost

The Davis Sewing Machine Company, Dayton, Ohio, has in its plant a direct-current turbine blower supplying blast air to its heat-treating department. Since it was the only unit furnishing blast air to this department, it stopped operation in that part of the plant when shut down for repairs. The company also has a Connersville blower furnishing blast air to its gray-iron foundry cupola, which is run only about one and a quarter hours per day. The plan was conceived, therefore, as an emergency measure, to run a pipe line from this blower and connect it to the piping in the heat-treating department. On two or three different occasions this emergency connection has prevented a shut-down in the heat-treating department when motor troubles made it necessary to stop the direct-current turbine blower. This emergency connection has probably saved the cost of an emergency blower outfit.

Dayton, Ohio. J. E. DAVIS.

SEVERAL TRANSFORMER STATIONS PREFERRED TO ONE

Assure Flexibility of Operation for Industrial Plant and Reduce the Cost of Low-Tension Copper Required for Motor Groups

A Massachusetts factory operating 136 motors with a combined rating of 3600 hp. prefers to distribute energy for motor service from four transformer substations instead of supplying the plant from one installation. The factory is across the way from a large public utility plant from which all energy used is purchased. Four 2300-volt cable lines are run underground from the feeder bases of the central station to the factory distributing substations, which are rated at 300, 600, 1200 and 1500 kva. Motor service is supplied at 440 volts and factory lighting at 110 volts. The electrical department of the factory maintains that, although the area of the plant is small enough to justify distribution from a single substation, the subdivision adopted increases the flexibility of the service, frees the establishment from the heavy expense of a shut-down due to the failure of a main cable or transformer, makes repairs and part-time operation convenient, and reduces the quantity of low-tension copper required.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Methods for Increasing the Use of Electric Light, Power and Heat

EMPLOYEES' INSTRUCTIONS THAT MAKE FOR COURTESY

How Application Clerk's Job May Be Explained to Him in Language That Will Make Him Appreciate Its Importance

Believing that more good will is made or lost at the application counter in the central-station office than at any other point of public contact, John Swanson of the Consumers' Power Company illustrated before the Michigan Section, National Electric Light Association, how to instruct clerks that start on this job. There are two ways in which such an order clerk will come in contact with the public. One is through telephone conversation and the other is through personal contact. To cover these two cases the instructions to clerks might be given as follows:

"In the case of contact with our customers over the telephone, an unusual amount of care should always be exercised, so that you will not appear to be discourteous, argumentative or in a hurry. Remember that the telephone robs you of the good offices rendered by your personality, and consequently you have to rely upon the tone and pitch of your voice, together with a general spirit which should evidence your desire to convince or assure our customer of your interest in his respective requirements. Furthermore, always bear in mind that the public is just as busy as you are, and that it is not going to the trouble of looking up our company number in a directory just to telephone us for the purpose of mere pastime. The moment the telephone rings it spells with no degree of uncertainty 'Opportunity for service.'

"When one of our customers comes into our office to requisition service and waits the pleasure of dilatory clerks, at once he begins to contrast the treatment given him with the prompt and efficient service of private business. Consequently, the many great things which should naturally come from community ownership and control of public necessities are at once discredited, and you are the direct cause. To forget this is to do the company's interests irreparable damage and undo much that has been accomplished by other departments and individuals through years of previous endeavor.

"Nobody ever amounted to very much who was so situated that he was entirely bereft of the privilege of coming in contact with people. Our whole social fabric is built upon the direct results of the social order of things. Even the animal kingdom reflects this law. To understand correctly the principles that make people enjoy meeting you and have confidence in what you say is to understand one of the fundamental assets in your life. Our company fully realized all this when they chose you to meet our customers at the order desk. This is the place of personal contact.

"A general neatness of appearance, a smile on your face, coupled with a self-evident desire to become accommodating, places our new customer at perfect ease and compels him to be sociable. From this point of contact you have established a friendly basis to begin the discussion of business. He feels immediately that he has come to requisition our company for a class of service which we are desirous and anxious to sell and just as anxious to deliver in an accommodating manner. Questions will come up that are perhaps a little difficult to answer in connection with some business transactions. These difficult points should always be taken up with the chief clerk and ironed out. Never get around answering any problem at the order desk by saying: 'It's the company's rules.' In a sense, you are the company, and with this idea in mind avoid religiously any reference to rules, regulations and requirements. It is never necessary so to direct your conversation as to emphasize instructions."

THE JUSTICE OF THE POWER-FACTOR RATE—II

Fairness of a Charge Generally Upheld, When Properly Evaluated and Justly Applied—Methods to Be Followed in Enforcing It

BY A. G. DARLING

Suitable equipment to meter the consumer's phase angle will depend somewhat on the type of rates under which the consumer buys his power. Of all the various schedules two general types are in effect, namely, "meter rates" and "demand rates."

By the term "meter rates" is meant any method of charge for electric service based solely upon quantity. By the term "demand rates" is meant any method of charge for electric service which is based upon or is a function of the use or size of the customer's installation or maximum demand during a given period of time. This rate may, in addition, include an energy charge or a customer charge or both. For simplicity, we will consider the unit of demand to be kilowatts.

The division of the two types is classified as follows:

Meter Rates.—Straight-line meter, step meter, block meter.

Demand Rates.—Flat demand, Wright demand, Hopkinson demand, Doherty or three-charge, load-factor.

All of these rates require watt-hour meters except the two demand charges, namely, flat and Wright demand rates. In addition, the demand rates may require demand meters in continuous or intermittent service.

It is then desired to secure metering equipment of two styles, first, to accompany simple watt-hour meters; second, to accompany watt-hour and demand meters. Any additional equipment should not duplicate present equipment unless it replaces it.

It is not apparent from the conclusions on power-factor valuation that any one style of metering equipment should be adopted in preference to any other.

The other factors that enter into a choice of metering equipment are rather those of accuracy, expense of equipment and its operation, together with the cost of billing under the scheme considered. Not a little success of power-factor metering will be due to the psychological effect of the results upon the customer.

[The concluding article on this subject by Mr. Darling, to appear in next week's issue, will discuss types of meters.]

EFFECT OF CAREFULLY DIRECTED ADVERTISING

R. S. Hale Says that Central-Station Advertising Man Should Show Executive Probable Final Results of Campaign

"The advertising man should always be able to judge, or at least guess at, the probable effect of his advertising on the gross business of the company; but that is not enough for the executive. It is the effect on the net profits, it is the probable final result, that guides the executive in his decision as to which of several plans will be the best."

This course was recommended to the advertising man of the central-station company by R. S. Hale, superintendent special research department Edison Electric Illuminating Company of Boston. Mr. Hale's discussion supplemented the paper of L. D. Gibbs, presented before the Sales Managers' Association at Association Island, N. Y., an abstract of which was printed in the ELECTRICAL WORLD of Aug. 30, 1919, page 477.

Treating of the "Economics of Advertising," Mr. Hale divided advertising into: (1) Advertising that is a service for carrying on the business; (2) advertising that is a promotion for increasing the business.

Though no sharp line can be drawn, yet in the first class are clearly placed such things as railway timetables or the sign over the door that directs people where to enter.

"The distinction between service advertising and promotion advertising," said Mr. Hale, "is an important one. There is also another line of distinction which is a little different and also very important. It depends on looking at the problem not only from a different angle but from an entirely different viewpoint, and then this viewpoint brings out the reasons why advertising sometimes pays and sometimes does not pay.

"In the problem of advertising, as in all other problems, we start with some definite set of conditions, which may be described as the budget or plan for the next year and future years. Such a budget always exists in the mind of the executive, even if it is not put on paper. The budget of to-day is a set of figures of the future balance sheets such that the executive will say, if they come true, 'This is what I expected.'

"While no one *knows* the future, yet every one has an expectation of the future based on present conditions.

"These expectations are seldom or never put down in full detail; nevertheless, they exist in the executive's mind. He figures: 'If I make no change in my orders to my subordinates (including the advertising man), there will be so many kilowatt-hours sold to so many customers, who will pay so many dollars. We shall run our turbines so many hours, use so many tons of coal, use so much labor and so much of other supplies, pay so much interest on our debt, pay so much in dividends, buy so much new apparatus, set up so much for reserve and have so much surplus or deficit.'

"Included in this budget or subconscious estimate by the executive is usually an expenditure for advertising, whether for service advertising, such as a simple catalog, or promotion advertising.

"When he considers the advertising problem, he considers what will be the effect if he spends, say, $10,000 for advertising in the daily newspapers.

"He figures that this will mean so many more kilowatt-hours sold, so much more coal, so much more labor, so much more expenditure for new service or plant, so much more interest or dividends on the new money, so much more income, and he finally decides what he had better do, as between the present budget, based on no change in his orders, and the new budget, based on telling his advertising man to spend $10,000.

"If on a central station each customer doubles the use, it is one thing. If, on the other hand, the central station doubles the number of its customers, putting in no new lines, but only new services, it is another thing; while if a central station doubles by going into virgin territory, the case is still different."

Mr. Hale showed that such an analysis clearly points to the importance of directed advertising—*i. e.*, to the importance of advertising strenuously in some cases and not advertising or promoting at all in other cases.

"As an example," he added, "we have the conditions of the off-peak business. We can usually afford to stimulate fan business, heating business and power business, since on the whole each kilowatt-hour thus used increases expenses less than kilowatt-hours used for lighting. Even if we make lower rates for this off-peak business, they are a form of promotion advertising, and in any case the question is, will advertising or promotion directed at some particular form of business increase the net profits enough to warrant the advertising? We might even get off-peak rates so low that it would pay to stimulate peak business by advertising. The conditions are different in each case, but the problem always is:

"What will happen if we go along without change?

"What will happen if we make some change, as an expenditure for advertising, a cut in rates or some other definite change?

"Finally, which is best of all the possibilities we have considered?

"In central-station advertising a case might be made out for directing the advertising solely at customers adjacent to our lines. This is seductive since a new customer who requires only a service is much more profitable than if an extension of lines is required. If, however, the extension of lines goes along a street with many prospective customers, the general budget should include an allowance for the advertising power of the new line and customer.

"In my opinion 90 per cent of the growth of the ordinary central station is the result of the talk of its existing customers, not that the customers intend to do advertising for the company, but every time a customer speaks of electricity he really does advertise our service. Therefore at present every new customer, even if he is individually unprofitable, still helps to get other profitable customers.

"However, the fact that the new line may be worth while because of its effect in getting still more business does not lessen the importance of considering each

case and of always directing the advertising. General advertising, it must be remembered, is also directed advertising in the sense that we consciously decide to direct it generally, and not at some particular feature. Obtaining the good will of the public is general advertising which is directed at the whole business. Such work is one job of the advertising department, though other departments should also obtain good will. The important point is the comparison of two or more budgets or sets of expectations, and basing the final decision on a comparison that includes all the things that affect net profits."

CONTRACT STANDARDIZED FOR ALL CLASSES OF SERVICE

Use of Same Contract with Different Riders for All Prospective Customers Saves Many Forms and Much Time

All customers of the Commonwealth Public Service Company, which serves a group of coal mines and small cities in Arkansas and Oklahoma, sign the same general contract, regardless of whether they are small residential customers or large power customers. The general contract is a letter-sized folder printed in readable type. On one of its pages is a blank space about 2 in. (5 cm.) high and running the full width of the page. In this blank space the differentiation between customers is made. If the prospective customer wants lighting service, the company's clerk or salesman pastes in a lighting rider carrying the general lighting rate. If the customer's installation consists of 25 hp. or more in motors and operates at 2300 volts, three-phase, 60 cycles, a rider carrying the wholesale power rate is pasted in. To special customers with seasonal loads like cotton gins special rates are given on special riders pasted into the general contract.

The rider reproduced above shows the general lighting rates followed by the special cotton-gin schedule.

COMMONWEALTH PUBLIC SERVICE COMPANY

General Lighting Rate—Schedule A.
Single Phase, 60 Cycle Current, 110 Volts.

For all lighting, and for motors of less than 1 Horse Power, and for certain apliances·

First	20 KWH	per month	.15 per KWH
Next	30 KWH	per month	.14 per KWH
Next	50 KWH	per month	.13 per KWH
Next	100 KWH	per month	.12 per KWH
Next	200 KWH	per month	.11 per KWH
All Over	400 KWH	per month	.10 per KWH

DISCOUNT Ten per cent for payment within ten days from date of rendering bill.

MINIMUM BILL $1 00 per month net.

Cotton Gin Rate—Schedule A.
2300 Volts

Total monthly consumption at 4½c per KWH Minimum bill $1 00 per Horse Power connected load per month, to apply only when current consumed at above rate is less than minimum charge

The charge for services under this rate to be made only for ginning season, or from date of connection to date of disconnection. But one connection and one disconnection will be allowed per ginning season

Notice to connect or disconnect must be served in writing by customer on company at least ten days in advance of such requirement.

DISCOUNT Ten per cent for payment within ten days from date of rendering bill

RIDER ATTACHED TO GENERAL CONTRACT

ADVICE ON STARTING IN MERCHANDISING BUSINESS

Emphasis Placed on Importance of Converting Own Organization to Value of Sales Effort and Education of Repair Departments

Any central station in a city of 200,000 population can readily develop a merchandising business that will show a gross volume of $1.50 per capita. In smaller communities the sales per capita should be even higher. This is the opinion of Walter S. Byrne, expressed before the Nebraska Electric Light Association at Grand Island during its recent convention. Mr. Byrne said further:

The public can only be sold after your organization is sold. No effort should be considered too great to accomplish this fundamental necessity at starting. The next thing to do is to select, irrespective of the selling price and discount, the types of appliances in which you have confidence and on which you are willing to stake your good name and reputation.

Third, secure from the manufacturer of these appliances the services of one of his factory experts who not only knows the quality and workmanship of the device in question but can bring the story home to your own sales force, your repair force, and in fact your entire organization. Convince them that this is the appliance that they should use in their own homes and make it attractive for them to use it. Derogatory comment by a repair man can "un-sell" more appliances in one hour than your sales force can put out in a month.

Fourth, be prepared to give service on these appliances which is rapid and expert.

Fifth, demonstrate these appliances to the user in such a way that he will unquestionably be served in their proper use.

Sixth, bear in mind the fact that if you have not been merchandising in a broad way, it is necessary to overcome the flywheel effect of your organization. This may be accomplished, at least initially, by offering your organization and the public some inducement to buy the appliances. "Inducement" does not necessarily mean promiscuous price cutting. It means judicious use of proper inducement which will lead to the placing of the devices in the homes of employees and customers.

DIGEST OF ELECTRICAL LITERATURE

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Cores and Coils for Transformers — II. — ARTHUR PALME.—The construction and forms of coils used in different types of transformers are discussed. It is shown how the forms of coils have changed to meet the increased capacity and to make possible the insulating of modern high-voltage transformers. The method employed to prevent distortion of the coils due to the tremendous forces set up when a short circuit occurs is touched upon.—*Power*, Aug. 12, 1919.

Conditions for the Stability of Working of Alternators.—A. BLONDEL.—This article contains the mathematical development of the theory of the working of alternators established by the author previously. The general and the particular case in which the compoundage and the oscillations in the inductor circuits are zero are considered. The effect of the angular width of the poles can in certain cases be important for the stability of working. In general, the slightest hyper-compoundage renders the working unstable at zero load. The case of the exciting dynamo coupled to the alternator is also considered, and it is demonstrated that the speed oscillations of the whole have but a small influence upon the working of the alternator.—*Science Abstracts, Section B*, June, 1919. (Abstracted from *Comptes Rendus*, March 24, 1919.)

Lamps and Lighting

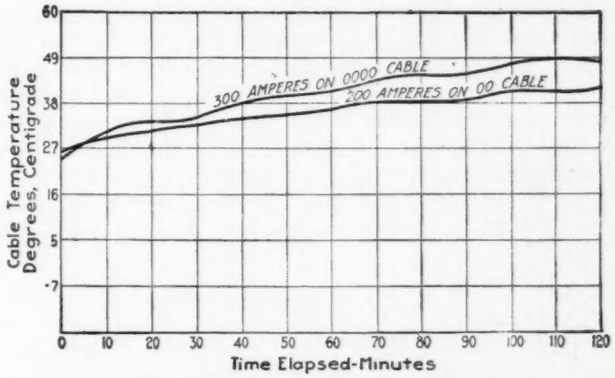
Electric Emergency Lighting.—The firm of Ruhstrat of Gottingen has produced an automatic system of emergency lighting suitable for factories, theaters, etc. The emergency lamp is supplied by an accumulator and is connected to circuit by a relay that operates when the main supply voltage fails. The lamp may be switched on or off at will, but the relay resumes its operation as soon as the main supply is reëstablished. The accumulator is permanently supplied with a small charging current as long as the emergency lamp is switched off.—*Technical Supplement to Review of Foreign Press*, July 22, 1919. (Abstracted from *Elektrot. Zeits.*, May 22, 1919.)

Permissible Voltage Variation with Metal-Filament Lamps.—Sudden voltage variations of 1 per cent are hardly noticeable with metal-filament lamps. Such variations of 3 per cent are just permissible. Infrequent variations of 3 to 4 per cent are very disturbing, and still greater variations should be avoided at all costs. Comparative tables are given that show the variations of resistance and candlepower of carbon-filament and metal-filament lamps with variation of applied voltage. A table is given for the percentage variation of the candlepower, specific consumption and the life of metal-filament lamps for voltage variation ranging between limits 5 per cent above and below the rated voltage.—*Technical Supplement to Review of Foreign Press*, June 24, 1919. (Abstracted from *Elektroindustrie*, May 1, 1919.)

Generation, Transmission and Distribution

Methods of Increasing Boiler-Room Efficiency.—D. S. JACOBUS.—The writer points out the necessity of equipping the boiler room with proper indicating and recording instruments and the necessity of having clean feed water. He makes some brief suggestions concerning furnace and stoker design.—*Power*, July 15, 1919.

Heating of Underground Cables.—A. L. FREERET.—The writer gives results of heating of various cables at constant current to show what current the cable will stand continuously without overheating. In the illustration are shown the results of tests on No. 2/0 cables at 200 amp. and No. 4/0 cables at 300 amp. These currents



HEATING OF CABLE UNDER INTERMITTENT LOAD

were applied for one minute and the temperature rises recorded. Then current was cut off for two minutes, and this process was kept up for two hours, in order to determine the approximate temperature rise which might be expected in the case of actual intermittent service conditions. The author concludes from his tests that with an intermittent load one minute on and two minutes off an underground cable need only have 56 per cent area of the conductor for carrying the same load continuously.—*Journal of Engineers' Club of Philadelphia*, August, 1919.

Suppression of Intermittent Earths.—SCHMITTUTZ.—The author questions whether the means and conditions for suppressing intermittent earths are quite so simple and definite as stated by W. Petersen. Frequently there are 100 or more horn-gap arresters in an overhead system, and in an example given the effective neutral resistance required is 2000 to 800 ohms, so that the operation of more than three arresters would give no protection. With reference to the protection of a cable system, it is pointed out that the delay in breakdown of a spark gap by very high-frequency current or by steep wave fronts is not to be neglected, especially if the electrodes yield an asymmetric field. In such cases the air in the gap is ionized, energy is dissipated, and the breakdown of the gap may be delayed so long

that the cable breaks down first. It is owing to the uniformity of the field between spherical electrodes that the sphere-gap arrester is so effective in discharging steep-wave-front surges. Earths in cables are usually not interrupted until the current supply is interrupted by operation of automatic switches. Protection by a permanently connected resistance between phase and earth, the value of this resistance being based upon the capacity of the network, is economically impracticable owing to the magnitude of the resultant waste of energy. For instance, Petersen's recommendations would result in a steady loss of 50 kw. from a 250-km. overhead line operated at 25,000 volts. As regards connection of resistance between generator and transformer neutrals and earth, this is apt to cause serious disturbance to telephone systems, apart from the difficulty of linking together the neutrals of a number of generators operating in parallel and often of very different types. The "earth coil" is the best means of suppressing the ill effects of earth faults, but it remains to investigate fully its efficacy with regard to high-resistance faults as distinct dead earths. Schmittutz suggests that the advantages of the earth coil may be secured without permanent earthing of the neutral by arranging that the neutral is earthed through an earth coil when, but not until, an earth fault occurs. In his reply W. Petersen states that good results have been obtained in Europe with earthed neutrals and that telephone interference is not serious. If an earth coil be not permanently connected, its most valuable characteristic, namely, readiness to suppress a discharge at once, is sacrificed.—*Science Abstracts, Section B*, June 1919. (Abstracted from *Elektrot. Zeits.*, March 20, 1919.)

Distribution of Wattless Load Between Power Stations in Parallel.—G. BRECHT.—In the parallel operation of power stations which are coupled by an interconnecting line the distribution of wattless load is more or less arbitrary for any particular distribution of wattless load which gives minimum total loss in the coupled system. This is the case when the connecting line carries the difference betwen the wattless currents in the connected networks. The power factor of the connecting line may be very different from that in either network, and there is no justification for endeavoring to bring it into agreement with the network power factor. On the contrary, such attempts may have disadvantageous effects. The phase displacement in the interconnecting line becomes smaller or leading as the excitation is decreased in the supplying station or increased in that station which is drawing current from the other. It is easy for one station to operate at unity power factor, leaving the other station to supply the wattless current for both networks. The author derives an expression showing that the phase displacement in the coupling or tie line must be smaller the greater the power to be transmitted by this line and the higher its resistance relatively to other resistances of the networks. Leading current in the tie line may be desirable, for instance when the station carrying lighter load is operated at such power factor that it needs more wattless energy than the other. A numerical example is given in the original. The question of how best to divide the wattless load will increase in importance as interconnections become more common.—*Science Abstracts, Section B*, June, 1919. (Abstracted from *Elektrot. Zeits.*, March 20, 1919.)

Electrochemistry and Batteries

Radiant Resistor Furnace.—F. A. J. FITZGERALD.—The author describes a radiant resistor furnace for the distillation of low-grade or scrap zinc. This furnace is said to have produced several tons of refined zinc. The best results were obtained with a current of approximately 845 amp. at 65 volts or 55 kw. With this power the output was about 50 kg. refined zinc per hour.—*Proceedings A. E. S.*, Sept. 26, 1919.

Electrochemistry in Its Human Relations.—F. J. TONE.—It is pointed out that the three main elements of plant food are nitrogen, potash and phosphoric acid, the production of which is a problem of the electrochemist. It is said that chlorine is used in sanitation in increasing quantities, and that the drinking water of more than 20,000,000 people in this country is made safe by its use. The role of the electrochemist in the production of the various steel alloys by means of the electric furnace is then discussed. Finally it is said that the electrochemist has a very definite responsibility in the matter of conservation of coal through the utilization of water power.—*Proceedings A. E. S.*, April, 3, 1919.

Telegraphy, Telephony and Signals

Valve Transmitters.—A. MEISSNER.—The first part of this paper deals with the historical development of valves in Germany for wireless work, with special reference to the design of valves for transmission purposes, illustrations being given of early and recent types. The various tube characteristics are next discussed in relation to efficiency of operation, and the paper concludes with a discussion of the effect of the anode and grid couplings. The chief interest of the paper lies in the diagrams illustrating the various points dealt with.—*Science Abstracts, Section B*, June, 1919. (Abstracted from *Elektrot. Zeits.*, Feb. 13 and 20, 1919.)

High-Frequency Alternators and Their Regulation.—J. BETHENOD.—The theory of machines of the inductor and homopolar types, also machines connected to frequency changers, is considered with reference to resonance working. The conditions giving maximum output are deduced. Voltage regulation and methods of obtaining regulation are discussed. Finally, the coupling of two high-frequency alternators in a transmission system is treated. The alternators are driven off the same shaft; one is connected in the primary circuit of the oscillation transformer, while the other is connected in the antenna between the secondary and earth.—*Science Abstracts, Section B*, June, 1919. (Abstracted from *Soc. Franc. Elect.*, March, 1919.)

Wireless Receivers of the Italian Navy.—G. VALLAURI and G. DE LUIGI.—The adoption of undamped-wave transmitters in the Italian Navy led to a study being made of receivers capable of receiving both spark and undamped-wave signals. The type of receiver adopted was the so-called "ultraudion" receiver in which a single valve acts at the same time as oscillation generator and as detector. Three types of apparatus, according to the requirements of shore or ship stations, were built, the wave lengths ranging from 300 m. to 15,000 m. The electrical dimensions of the different parts, such as condensers, inductances, etc., are given, and the reasons which led to their adoption are explained. Diagrams of connections and photographic views are given.—*Science Abstracts, Section B*, June, 1919. (Abstracted from *Jahrb. d. Drahtl. Tele.*, January, 1919.)

Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

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Cornell University, Ithaca, N. Y.

Research in Progress or Completed

When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are refered to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.

GROUND DETECTOR VOLTMETER, ELECTROMAGNETIC.

A circular coil is pivoted on a universal joint at its center and is fed from a voltage in step with and proportional to the voltage between the generator star point and the ground. Along the axis of this coil is a pointer attached to the coil and carrying a "bull's-eye." The coil is acted upon by a revolving magnetic field coaxial with the same. The magnitude and the phase direction of the voltage between the generator star point and the ground determines the magnitude and the direction of the deflection of the coil and the motion of the "bull's-eye," thus indicating which leg is grounded and how heavy the ground is. This instrument gives deflections roughly proportional to the ground voltage instead of the square of the same as in the electrostatic instrument. The torque is also much stronger.—*H. S. Baker, Hydro-Electric Power Commission of Ontario, Niagara Falls, Ont.*

METER, WATT-HOUR, EXCESS POWER.

In some contracts on power supply the excess power over a stipulated demand enters as an element in making out the bill. Therefore a watt-hour meter is desired which stands still at any rate of consumption of energy below this minimum, and runs at a rate proportional to the excess power. The problem is one of providing a constant counter-torque on the shaft of the meter and a ratchet arrangement which would prevent the meter from running backward. If this counter-torque be provided by means of the usual split-phase magnet acting upon an aluminum disk, care must be taken that the current through this magnet be practically constant with a widely fluctuating voltage and frequency of the power supply. One way in which this has been accomplished is by means of a non-inductive resistance in series with the magnet winding. This resistance is periodically short-circuited by a contact as in the Tirrill regulator. The motion of the contact is controlled by a constant weight which keeps the average current practically constant.—*H. S. Baker, Hydro-Electric Power Commission of Ontario, Niagara Falls, Ont.*

RESISTIVITY OF COMPOSITE MATERIALS.

Researches on the resistivity and surface breakdown strength of some of the more recently manufactured composite materials are being undertaken with a view to obtaining data for the publication of a complete specification for these materials. This work is being conducted under the joint auspices of the Institution of Electrical Engineers and of the British Electrical and Allied Manufacturers' Association.—*E. W. Marchant, University of Liverpool, England.*

TRANSMISSION-LINE NETWORKS, CALCULATION OF.

The object of this investigation has been to obtain a general and flexible method of calculation applicable to networks consisting of individual three-phase transmission lines connected together in any manner, as, for instance, in the Hydro-Electric Power system of Ontario. The method is limited to sine waves, and complex quantities are used throughout. The current and voltage relations for each element of construction—namely, transmission line or transformer group—being known in advance as a binary linear transformation, similar relations (matrix of determinant unity) are found to exist for the following cases: (1) For a group of any number of transmission lines in parallel; (2) for a new group consisting of any such group in tandem; (3) for lines or line groups with intermediate loads taken as admittance; (4) for lines with intermediate power loads regarded as reversed admittances; (5) for connections to a distribution circuit through transformers; (6) for any complex group obtained by successive application of the above groupings. The simpler cases of groups and of tie lines are covered by the above. The general tie-line problem is that of any number of branch points connected together by transmission lines. This also has been solved. The investigation will be published in the first bulletin of the School of Engineering Research, University of Toronto.—*T. R. Roseburgh, Toronto, Ontario.*

VOLTMETER, DIFFERENTIAL, FOR SECTIONALIZING BUSBARS.

Consider the case of sectionalized busbars in a large power plant, the individual sections being connected by means of current-limiting reactors with oil switches in series. Let these switches have a time limit of one second and let the outgoing line switches have relays set at two seconds. When there is trouble on one of the lines it is desirable to cut out the busbar section to which this line is connected before the line switch opens. The rush of current through the sectionalizing choke coil, together with the drop in voltage in the generators connected to the faulty section, is utilized to operate a differential voltmeter, which trips the circuit breaker in series with the choke coil. This isolates the faulty section and makes it easier for the line switch to clear the trouble, because there is less power behind it. Overload (ampere) relays are also provided on these reactors with two and one-half seconds time to avoid overheating the reactance coils. Very heavy loads at unity power factor may be fed through a set of reactors without producing any arithmetical difference of voltage between the bus sections. The differential voltmeter relay detects the arithmetical difference caused by the trouble. Such an arrangement is in successful operation in the power plant with which the writer is connected.—*H. S. Baker, Hydro-Electric Power Commission of Ontario, Niagara Falls, Ont.*

Research Contemplated

INSULATING MATERIALS, POWER LOSS AND TEMPERATURE.

The most useful and important measurement at radio frequencies is that of power loss, because the effects of voltage at such frequencies are determined mainly by the rate of heat production in the material. It has been found that this quantity changes with the time in the case of some grades of phenol insulating materials. These changes can be reduced or reversed by heating at a fixed temperature for several days. Experiments such as this should shed some light on the completeness of the reactions used in manufacturing the material. This has a most important bearing on the permanence of the materials when used in practical apparatus. The variation of the electrical properties with temperature is to be studied. The effect of moisture is to be thoroughly investigated by measuring certain properties on three batches of samples kept (a) exposed to outdoor weather, (b) immersed in water, (c) in the laboratory atmosphere. The weight and the power loss are to be measured at regular intervals. Preliminary experiments have shown interesting changes. Measurements are to be made, in coöperation with the manufacturers, on the effect of carefully selecting the grade of paper, etc., used in making up the insulating materials. Data will be obtained for comparison of the various properties of the laminated materials with other available insulating materials such as hard rubber, wood and porcelain.—*Bureau of Standards, Washington, D. C.*

Suggestions for Research

BRUSHES, CHATTERING OF.

The real cause of the chattering of brushes, so far as I know, has never been found out. One can have bad chattering of brushes with the most perfect polish on the commutator and brushes and with mechanical conditions of support such as *per se* not to cause chattering. I believe that chattering is often caused by a heating effect somewhat analogous to the effect observed in the Trevelyan rocker. Sometimes brushes do not chatter when the commutator is cold but chatter badly when the commutator is hot. The whole question of the effect of the slope of the brushes in the holder and the method of support needs thorough scientific investigation. Most engineers have pet theories of the right inclination to give to a brush in the holder, but I have never come across any satisfactory solution of the problem of holding a carbon brush, either in theory or in practice. In view of the millions of watts that are being wasted owing to bad brush contact and to brush friction, it would be well worth while spending a great deal of time and money in ascertaining how to support a carbon brush so as to insure the closest permanent contact between carbon and copper.—*Miles Walker, College of Technology, Manchester, England.*

CABLE BURNOUTS.

A good subject for research would be the following peculiar action of some large lead-covered single-conductor cables under load. I have in mind an installation where there are six 1,000,000-circ.mil lead-covered cables operating two in parallel on three-phase, 11,000-volt service. These six cables are tied together at one end and grounded and are insulated from ground over their entire length. The other ends are not tied together and neither are they grounded. They are spaced approximately 1 ft. (0.3 m.) apart, and are about 2 in. (5 cm.) in diameter. Since these cables do not form a closed circuit there can be no flow of current due to transformer action. The voltage generated in the sheaths due to this action should not be excessive, yet these cables have punctured to ground several times, completely burning up the lead sheaths for a distance of several feet at each failure. It would be interesting to know what causes these failures and what the remedy would be.—*D. C. Black, Duquesne Light Company, Pittsburgh, Pa.*

FURNACE, ELECTRIC, FOR HEATING INGOT CHARGES.

In the making of high-grade steel it is very important to cool ingots quite slowly in order to allow time for slag and impurities to rise to the surface. In some cases it is even desired to keep ingot charges at the original temperature. An electric heater or furnace is needed for this purpose, and the difficulties in the problem are many owing to the large amount of heat and the high temperature required. An induction-type heater would be an ideal solution if a large enough source of high-frequency currents were available.—*Dr. Edwin F. Northrup, Pyro-electric Instrument Company, Trenton, N. J., and Douglass Burnett, Consolidated Gas, Electric Light & Power Company, Baltimore.*

LAMPS, STREET—TURNING ON AND OFF ELECTRICALLY.

There is a tendency to replace series street lamps by those connected in parallel and fed from the secondary of a distributing transformer (for house lighting) in the neighborhood. A simple arrangement is desired whereby these street lights may be turned on and off from a distant point where an employee of the lighting company is stationed. This should be done without the use of pilot wires. One suggestion made was to lower or to raise the frequency of the supply for an instant, and to have a frequency meter act as a relay to close the local switch. This method has its difficulties and limitations, and other means are desired.—*Editorial Suggestion.*

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

FIRE AT AIR-NITRATES PLANT IS NOT SERIOUS

Warehouse Containing Salvaged Electrical Material Destroyed, but the Power Plant Itself Is Uninjured

On Monday there was destroyed by fire a wooden building about 600 ft. long containing the salvaged power plant and construction material from the government air-nitrates plant at Muscle Shoals, Ala. Contrary to statements in the newspapers reporting a loss of $2,000,000 in new electrical material, the ELECTRICAL WORLD received a statement from Major Sullivan that the entire loss would not total $100,000.

The power plant of the nitrates development was near by the destroyed building, but suffered no loss. The operators were able to continue the plant test, on which reports are soon expected.

NEW BUREAU OF MINES LABORATORY AT PITTSBURGH

Electric Mining Equipment Submitted by Manufacturers to Be Tested to Determine Safety for Use in Gaseous Coal Mines

The Bureau of Mines, Department of the Interior, in coöperation with the Pittsburgh Chamber of Commerce, intends to dedicate its new million-dollar laboratories at Pittsburgh, Pa., with appropriate national ceremonies on Sept. 29 and 30 and Oct. 1.

Considerable space in the new building has been provided for the electrical section of the mechanical division. The work of this electrical section that is carried on at the Pittsburgh station has largely to do with the testing of electric mining equipment, submitted by manufacturers, to determine its safety for use in gaseous coal mines. Equipment that passes the tests prescribed is approved by the bureau. As a result of this work mining has been made immeasurably safer, the bureau feels, and the use of equipment approved by the bureau is being rapidly extended. Apparatus is tested under schedules issued by the bureau from time to time as the need of a particular class of apparatus develops. The types of apparatus for which schedules have been issued to date include the following: Permissible portable electric mine lamps, permissible electric motors for mines, permissible miners' safety lamps, permissible gas detectors for mines, permissible mine-locomotive headlights, permissible electric lamps for mine-rescue service, and permissible flashlamps that are safe for use in explosive mixtures of methane and air.

These schedules are becoming widely known throughout the mining industry, and a large proportion of the miners, the bureau states, are using apparatus so approved.

MANY N. E. L. A. COMMITTEE MEETINGS TO BE HELD SOON

Itinerary of the Second Eastern Trip of President Ballard Includes the Conventions of the Southeastern and New England Sections

President R. H. Ballard of the National Electric Light Association left Los Angeles Sept. 12 on a second Eastern trip in the interests of the organization. He will attend a meeting of the public policy committee which has been called by Chairman John A. Britton to be held at association headquarters in New York City on Oct. 14. Both Mr. Ballard and Mr. Britton will be in attendance at this meeting. A meeting of the executive committee is called for Oct. 2, when the southern California city at which the convention of 1920 will be held will probably be selected. A general meeting of the committee on geographic sections has been called by Chairman R. F. McClelland and Vice-president Bump for Sept. 29. It is expected that this meeting will be in session for two days, as the general question of dividing the country into geographic sections will be taken up and thoroughly discussed and some definite program will be agreed upon.

Taking advantage of President Ballard's presence in the East, a general meeting of the membership committee has been called by Chairman Walter Neumuller of New York, and of the company sections committee by Chairman Frank A. Birch of Philadelphia. Both of these meetings will be held in New York.

Conferences have been arranged between President Ballard, Vice-president Bump of New York and Chairman I. R. Moultrop of Boston on affairs relating to the Technical and Hydroelectric Section, with Vice-president Walter H. Johnson of Philadelphia and Chairmen John G. Learned and George B. Foster of Chicago on matters connected with the Commercial and Electric Vehicle Sections, and also with Vice-president Frank W. Smith of New York and Chairman R. W. Symes of Detroit concerning matters appertaining to the Accounting Section. The president was scheduled to stop in St. Louis on Sept. 15 for a discussion of association affairs with company executives.

The convention of the Southeastern Section, which was held at Asheville, N. C., Sept. 17 to 19, was addressed by President Ballard on Thursday morning.

The convention of the New England Section will be held at New London, Conn., Sept. 22 to 24. President Ballard will speak at the banquet on the evening of Sept. 23. At the close of the New England convention he will return to New York, arriving there the evening of Sept. 24, and he plans to be at headquarters for the following two weeks. Returning to the Pacific Coast in October, President Ballard's tentative itinerary provides stops at Detroit, Chicago, Minneapolis, Butte, Seattle, Portland and San Francisco.

SENATE COMMITTEE REPORT ON THE WATER-POWER BILL

Favorable Action Without a Dissenting Vote—Bill Now Before Senate for Consideration—Changes Made in Conference

Without a dissenting vote the Senate committee on commerce agreed, on Sept. 11, to report favorably the water-power bill. A number of changes were made in the measure by the committee on commerce and by the Senate public land committee. Most of the changes, however, were of a minor nature, and little difficulty is anticipated in securing the agreement of the House to the Senate bill if it is passed in its present form. It is known, however, that Senator Lenroot is planning a formidable fight against the bill, and it is not at all certain that the opposition will be unable to secure some of the changes it will advocate.

The first change made by the Senate committee was to increase the salary of the executive secretary of the Federal Power Commission from $5,000 to $6,000 a year. The Senate committee struck out the definition of the word "reservations" and inserted its own definition as follows: "Reservations" means national monuments, national parks, national forests, tribal lands embraced within Indian reservations, military reservations, and other lands and interests in lands owned by the United States and withdrawn, reserved or withheld from private appropriation and disposal under the public land laws; also lands and interests in lands acquired and held for any public purpose.

DEFINING "NAVIGABLE WATERS"

Another change was made in the definition of "navigable waters," which the commerce committee held means those parts of streams or other bodies of water over which Congress has jurisdiction under its authority to regulate commerce with foreign nations and among the several states, and which either in their natural or improved condition, notwithstanding interruption by falls, shallows or rapids compelling land carriage, are used or suitable for use for the transportation of persons or property in interstate or foreign commerce, including therein all such interrupting falls, shallows or rapids, together with such other parts of streams, as shall have been authorized by Congress for improvement by the United States or shall have been recommended to Congress for such improvement after investigation under its authority.

In the definition of the term "cost" the Senate committee specified that the Interstate Commerce Commission's classification of investment in road and equipment of steam roads is to be promulgated as a part of the rules and regulations. One of the conditions under which licenses are to be issued (Section 10-e) was changed as follows:

That the licensee shall pay for the license herein granted such reasonable annual charges as may be fixed by the commission, for the purpose of reimbursing the United States for the cost of administration of the act in relation to water powers developed under its jurisdiction, in the proportion that the water power developed by the project covered by said license bears to the total water power developed by all projects licensed under the act, and for that purpose such charges may be readjusted from time to time not oftener than once in two years. The licensee shall also pay for the use and occupation of any lands of the United States necessary for the development of the project covered by the license such reasonable annual charges based upon the actual value of the government lands used as may be fixed by the commission, but in no event shall the annual charge for the foregoing exceed 25 cents per developed horsepower; provided that when licenses are issued involving the use of government dams or other structures owned by the United States the commission shall fix a reasonable annual charge for the use thereof, and such charges may be readjusted at the end of twenty years after the beginning of operations and at periods of not less than ten years thereafter in a manner to be described in each license.

Another condition was changed to read as follows:

In issuing licenses for a minor part only of a complete project, or for a complete project of not more than 200 hp. capacity, the commission may in its discretion waive such conditions, provisions and requirements of this act, except the license period of fifty years, as it may deem to be to the public interest to waive under the circumstances.

The proviso at the end of Section 14 of the bill, which had been struck out by the Senate committee earlier in its deliberations, was restored when the committee could not agree on allowing "severance damages" to remain in its rewording of the proviso.

"REASONABLE TERMS" INSISTED UPON

Much debate took place on the proviso at the end of Section 15. The commerce committee inserted the phrase "upon reasonable terms" after the words "new licensee," making the first portion of the proviso read as follows: "That in event the United States does not exercise the right to take over or does not tender a new license upon reasonable terms to the original or a new licensee which is accepted, then the commission shall issue," etc. The words "which is accepted" in the foregoing sentence were also inserted by the Senate committee.

Section 17 was stricken out entirely and the following substitute written in:

Sec. 17. That the charges arising from licenses hereunder shall be paid into the Treasury of the United States and shall be reserved as a special fund therein. Such part of said fund as Congress may from time to time direct shall be appropriated toward paying the costs of administration of this act and of conducting the investigations authorized by this act. The remainder of said fund, if any, shall be expendable under the direction of commission in the maintenance and operation of dams or other navigation structures owned by the United States or in the construction, maintenance and operation of headwater or other improvements of streams upon which the commission is authorized to issue licenses under this act; provided that all proceeds from any Indian reservation shall be placed to the credit of the Indians of such reservation.

A proviso was added to Section 23 as follows:

Provided that when application is made for a license under this section for a project or projects already constructed, the fair value of said project or projects, determined as provided below in this section, shall for the purposes of this act and of said license be deemed to be the amount to be allowed as the net investment of the applicant in such project or projects as of the date of such license, or as of the date of such determination if license has not been issued. Such fair value may, in the discretion of the commission, be determined by mutual agreement between the commission and the applicant or, in case they cannot agree, jurisdiction is hereby conferred upon the district court of the United States in the district within which such project or projects may be located, upon the application of either party, to hear and determine the amount of such fair value.

The latter portion of Section 23 was striken out and the following was substituted:

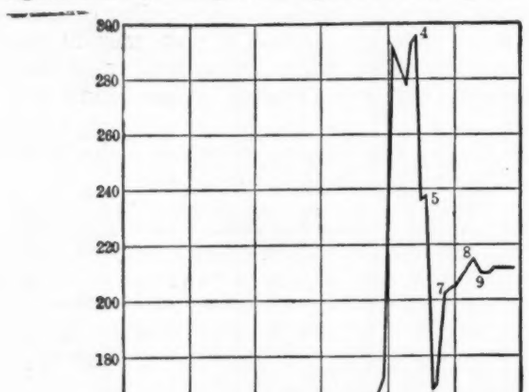
That any person, association, corporation, state or municipality intending to construct a dam or other project

works across, along, over or in any stream or part thereof, other than those defined herein as navigable waters, and over which Congress has jurisdiction under its authority to regulate commerce between foreign nations and among the several states, may in its discretion file declaration of such intention with the commission, whereupon the commission shall cause immediate investigation of such proposed construction to be made, and if upon investigation it shall find that the interests of interstate or foreign commerce would be affected by such proposed construction, such person, association, corporation, state or municipality shall not proceed with such construction until it shall have applied for and shall have received a license under the provisions of this act. If the commission shall not so find, and if no public lands or reservations are affected, permission is hereby granted to construct such dam or other project works in such stream upon compliance with state laws.

SIX YEARS' SPOT PRICES FOR BITUMINOUS COAL

Official Statistics Showing Relative Price per Ton by Months from 1913 to 1918 Inclusive Are Issued by the Geological Survey

A report by C. E. Lesher on "Prices of Coal and Coke, 1913–1918," prepared in coöperation with the United States Fuel Administration and the War Industries Board, has been published by the United States Geological Survey. It gives diagrams showing the relative



RELATIVE SPOT PRICES OF BITUMINOUS COAL 1913-1918

prices per ton of 2000 lb. of all bituminous coal produced in the United States, by months, from 1913 to 1918 inclusive. The accompanying illustration shows the relative spot prices in this period compared with the average spot prices in the twelve months preceding July 1913 to June 1914. The spot prices are taken from the market quotations of *Coal Age*.

Production 1917, 551,790,000 net tons. Average spot price, pre-war period, $1.27; average realized price, $1.17.

1, 2. The downward trend of the price of bituminous coal in 1913, 1914 and 1915 is shown by both the spot prices and the average prices realized. From a general average spot price of $1.47 in January 1913 (1) prices declined to $1.14 in July 1915 (2).

3. The strength of the demand in the winter of 1915–16, particularly manifested in the Eastern States, is indicated by the rise in the general average spot price to $1.54 (3).

4. The highest point reached by the general average spot price was $3.77 in June 1917 (4).

5. The amount of reduction effected by the Peabody prices is well illustrated by the drop in the curves from (4) to (5).

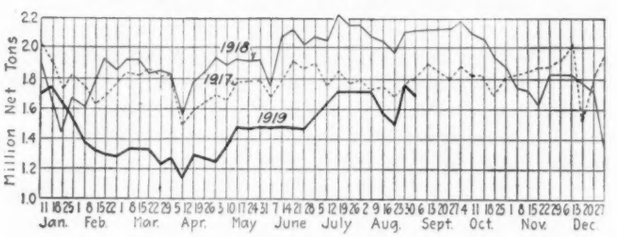
6. Likewise, the further decrease in the general level of prices brought about by the President's price of August 21, 1917, is shown by the drop in the curves from (5) to (6).

7. The general effect on prices of bituminous coal of the wage advance in November 1917 is indicated by the rise from (6) to (7).

8. Advances in price in various fields authorized by the Fuel Administrator as the result of investigations of the cost of mining raised the general level gradually to a maximum under government control in May 1918 (8).

9. The general reduction in price of 10 cents a ton on all bituminous coal ordered May 25, 1918, is reflected in the curves at (9).

Bituminous Coal Production Still Low



The Geological Survey returns on bituminous coal production show that the output is still below that of 1917 and 1918.

BOSTON ELECTRICAL SERVICE FULLY MAINTAINED IN STRIKE

Riots Occurring in Early Period of Police Strike Confined to Retail Districts—Military Forces Control Situation

The strike of Boston police, which began Sept. 8 and which was accompanied in its early stages by riots culminating in the death of seven persons and the injury of about forty others, had no effect upon the electrical supply service of the city. Up to this writing, energy has been furnished as usual on all the lines of the Edison Electric Illuminating Company, and no interruption has occurred in the telephone, telegraph and street-railway facilities.

On Monday and Tuesday nights of last week looting of retail stores occurred in various parts of the city. The electrical supply house of Edwin C. Lewis, Inc., at 121 Federal Street, suffered about $80 damage from broken window glass but lost no stock. So far as can be learned no other electrical concern was involved in any way in the disturbances, which were quickly quelled by the arrival of the State Guard, 7000 members of which, including many overseas veterans, were on duty by Thursday night.

The waterfront has been closed to unauthorized visitors, as in war time, and extra guards have been placed at important generating plants. The U. S. S. scout cruiser Chester was ordered to take up a position at the Boston army supply base, within easy reach of the

L Street station of the Boston Edison company, to coöperate in the maintenance of service from this main generating plant of the metropolitan district, should necessity arise. At the time of going to press the various utility properties at Boston remained intact, and full precautions are being taken to insure normal service.

KEY WEST ELECTRIC COMPANY SUFFERS FROM HURRICANE

Temporary Suspension of Service Caused by Damage to Distribution System, Which Serves 21,500 Persons in Florida District

The hurricane which swept over the waters of the Florida coast last week forced the Key West Electric Company to suspend its railway, lighting and power service for a few days on account of pole line damages. No employees of the company were killed or injured.

Inquiry at the Boston office of Stone & Webster, managers of the company, elicited the information that about twenty-five poles were blown down, while a portion of the generating station roof was swept away. The plant has a rating of about 2000 kw., the generating units being of the Diesel engine type. About 21,500 persons are served by the company.

The destruction of poles on the distribution system made it necessary to suspend trolley and other electrical service until Friday of last week, about three days' interruption of traction facilities. It was expected that the lighting and power service would be restored in part by Saturday. No particulars of the extent of the damage to the property from the financial point had been received by Stone & Webster Saturday, but from the accounts of the trouble sent North it is doubtful if the restoration of service will cost more than $5,000.

STATE COMMISSIONERS ARE TO MEET IN INDIANAPOLIS

Call for the Convention Says that It Cannot Be Safely Inferred that the Propaganda Against State Regulation Is Dead

Reports affecting all classes of public utilities will be made at the thirty-first annual convention of the National Association of Railway and Utilities Commissioners, to be held in Indianapolis, beginning Oct. 14. Among the reports to be presented will be that of a special committee on standardizing annual and special reports of companies, and reports for the following committees: Special war, public ownership and operation, safety of operation of public utility companies, service of public utility rates, statistics and accounts of public utility companies, valuation, capitalization and intercorporate relations, state and federal legislation, and publication of commissions' decisions.

A call for the convention, signed by Charles M. Elmquist, president, C. M. Candler, chairman executive committee, and James B. Walker, secretary, says, in part:

This announcement of our annual meeting need not discuss the history of events since the last meeting, nor estimate the probable course of legislation by Congress, to convince you of the vital necessity for a conference between, and complete coöperation by, the members of this association in meeting the problems which we as public officers face in both the transportation and public utilities fields.

The recently enacted wire return resolution is a vote of confidence in state regulation of the telegraph and telephone as a result of statements submitted to congressional committees by members of the association and your president.

The more recent report of the House committee on interstate and foreign commerce recommending amendments to the Cummins bill, suggested by your president, which will give state authorities the power to review increases in state rates while carriers are under federal control, is also a recognition of the necessity for state control of intrastate rates.

However, we cannot safely infer that the propaganda against state regulation is dead. Congress must be thoroughly informed of the facts concerning our dual system of regulation and the necessity for its continuance incidental to its consideration of the other very complex transportation questions, which every member of this association is no doubt studying with great care at the present time.

Justifiable pride in the accomplishments of the state commissions, a proper consciousness of our responsibilities to the public and a clear appreciation of the complex problems of reconstruction vitally relating transportation and utility services to our industrial fabric, all make it imperative that every member of this association—and that means every member of your commission—should attend the Indianapolis convention.

Boston Gas Company Employee on Board of Directors

Miles Connor, a profit-sharing employee of the Boston (Mass.) Consolidated Gas Company since 1906, was elected a director of the company Sept. 11. This action represents a new and advanced policy on the part of the company, designed to increase employee representation in the management of its affairs. The new director has received during his profit-sharing period 100 per cent of his average annual earnings in the company, which has been invested in the preferred shares of the Massachusetts Gas Companies, an affiliated concern. The Boston Consolidated Gas Company's profit-sharing plan consists of the purchase for the account of each deserving employee of at least twelve months' standing an amount of Massachusetts Gas preferred stock at the market value equal to the same percentage upon the wage of the employee as the rate of dividends paid on the stock of the Boston Consolidated company. Thus, last year's 7 per cent dividends would bring to a profit sharer whose wages are $1,800 a total of $126 in preferred stock.

Helpful Plant in Marquette Water Shortage

This is a bird's-eye view of the latest and largest hydroelectric development on the system of the Cleveland Cliffs Iron Company. The company mines iron ore in the Marquette Range on the upper Michigan peninsula. The plant shown here contains two 5000-kw. generators. The potential is stepped up from 2200 volts to 30,000 volts in the outdoor substation to the right of the power plant.

GROWTH OF CENTRAL-STATION SERVICE IN LOUISVILLE

How Louisville Gas & Electric Company Has Settled Many Cases in Favor of Centralized Instead of Isolated-Plant Service

A large part of the increased business of central stations is still obtained as a result of the closing down of isolated plants. What this means is illustrated by giving the facts over a period of years in a city of about 250,000 population.

In 1913 the several electric companies which were operating uneconomically for themselves and the public in Louisville, Ky., were consolidated under Byllesby management. Louisville is a city of many small manufacturing enterprises and none of predominating size. Owing to the activities of the Louisville Industrial Foundation twenty-seven new industries have been brought to the city during the last few years, and they all use electric service.

In the six years ended with June, 1919, the service of the Louisville Gas & Electric Company was substituted for ninety-one previously established isolated and industrial steam-operated power plants. The amount of power business thus added to the central-station company was in round figures 18,000 hp., and the lighting business from these sources 2000 hp., or an aggregate of 20,000 hp. transferred from ninety-one individually operated plants to the large modern power house of the company.

Of the ninety-one isolated plants closed down eleven were located in downtown office buildings and stores, the city hall, etc.; three were operated by railroads, four by tanneries, eighteen by woodworking establishments, nine by tobacco companies, eight in machine shops, four by flour and grain mills, two in brick and tile plants, and thirty-two were in miscellaneous industries, including woolen and cotton mills, chemical and food-products plants, soap factories, etc.

Reviewing the work of the commercial department of the Louisville company in the conversion of steam plants to central-station service, Walter D. Myers, sales engineer, states that many important questions have been settled once and for all time in favor of the centralized service. With reference to office buildings, municipal buildings and power plants serving a restricted district, Mr. Myers says they were all in the heart of the city, with fairly well-equipped direct-current plants, all supplying steam for building heating purposes. Three of the office buildings were equipped with hydraulic elevators. These things had to be accomplished:

First—To change equipment (fans and motor) to alternating current.

Second—To prove that the building could be heated and electric needs bought at a cost not to exceed the cost of operating power plant.

Third—To replace hydraulic elevators with electric elevators or install motor-driven pumps to replace steam-driven pumps. In either case the installation was expensive.

In discussing the situation Mr. Myers said:

The second disadvantage was the most serious to handle, as to a building manager the heating of an office is an enigma, especially when he has been led to believe by his steam engineer that his plant is primarily a heating plant and that the electricity needed to light the building is merely a byproduct and costs practically nothing.

This was overcome to a great extent by obtaining the cost of heating similar buildings that were purchasing electric service from the outside, but in some instances this evidence was not sufficient, and on one of the largest plants the yearly expense for lighting and heating the building was estimated and a clause inserted in the contract that if the first year's bill exceeded a given amount the customers were to have the privilege of canceling the contract. The result was that the building exceeded the estimate about $300 per year, but the management was so well satisfied with the superior service that it would not consider reëstablishing the old service.

Little trouble was experienced in changing over the plants of the three railroad companies, as their experience in operating plants, not only in Louisville but at other points, brought them to the conclusion of purchasing electricity where it is available at reasonable rates.

With few exceptions the Louisville tanneries are confined to the tanning of sole leather, and steam in large and consistent quantities is used for drying. From the standpoint of economy operation compared with purchased service, the power company was at some disadvantage, but, with increased output and relief from power-plant troubles, the tannery customers are well satisfied with results.

Woodworking is one of the principal Louisville industries, and, with its waste fuel and demand for steam for dry kilns, it is generally considered a problem for central stations, but efforts were centered on two or three of the largest plants at first and the business secured on short-term contracts. Their experience and satisfaction permeated the whole industry, with the result that the power company is now operating 90 per cent of the woodworking plants in Louisville.

PUBLIC OWNERSHIP COSTLY, SAYS EMERSON M'MILLIN

Declares that Public Ownership Will Be Unsuccessful as Long as Present Form of City Government Remains

Emerson McMillin, chairman of the board of the American Light & Traction Company, made an address on public ownership at a meeting of the National Civic Federation in New York on Sept. 11. Mr. McMillin declared that municipal ownership of public utilities is unsuccessful at present and that it will continue to be so as long as the present form of city government exists. He said that plants under private ownership are not only more efficient but that they give better service at a lower cost to the public.

"The cost of municipally owned utilities is usually higher when all the legitimate items of expense are given consideration," said Mr. McMillin. "The equipment installed in a municipally owned plant is usually too poor for effective service or badly adjusted to the operating demands. Business methods are usually lacking in municipally owned plants. The causes of the failures of these enterprises are to be found in the organization of the municipalities.

"In the matter of obtaining power business or any business other than that of private consumers, who of necessity must take the product, the work of the city-owned plant makes the worst showing of them all. In private companies the power consumption per 100 inhabitants averages nearly six times as much as with the city-owned plant."

Mr. McMillin said that privately owned properties are having great difficulty in meeting the increased cost of operation because of inability to get the cities to permit higher rates in spite of the advance in prices of all kinds.

INCREASED REVENUES ARE NECESSITY IN INDIANA

Technical Questions of Little Interest in Comparison with Discussion on Methods of Getting More Money and Central-Station Policy

There were five papers on management topics, including financing, rates, central-station policy and merchandising, and one technical paper at the annual convention of the Indiana Electric Light Association at French Lick, Ind., Sept. 11 and 12. The greater interest of the delegates in management topics was further shown by the prolonged discussions that followed the management papers, particularly those on rates, financing and merchandising.

Rates were more discussed than any other topic because the Indiana operators see now that the present high prices of labor, fuel, etc., are likely to be permanent. Rate increases which have been granted in Indiana are mostly temporary surcharges. Many of these are not high enough to permit the companies to make a financial showing on which bankers will loan money. Naturally, with high permanent costs to meet, the operators wish to secure comparable permanent rate increases so that the return on their present investments will be sufficient to attract the additional capital which is needed.

Thomas A. Wynne of Indianapolis touched on this point in his presidential address. Wages in the Indiana plants have not yet stopped advancing, he said. On the other hand, no dividends can be paid to stockholders of some companies under the present status of income and expense. Rates will need to be readjusted. This may entail a change in the Indianapolis Light & Heat Company's rate because analysis shows that 75 per cent of the company's customers, which are the small residential and commercial customers, are being served below cost, while a part of the deficit so created is being made up by surcharges on large power. This it is hoped may be readjusted so that each class of business will stand on its own bottom.

Mr. Wynne also discussed the coal situation, advising operators that many companies are still keeping up the fight to get clean coal. A telegram from Chairman Lewis of the Public Utilities Commission advised all operators to lay in adequate stocks of coal. He predicted higher coal prices.

The rate question was again brought to the front when J. W. Robb of Clinton, Ind., read a paper in which he gave the average cost to serve consumers in a small town as 92 cents without taking into account any electricity used. From this he argued that minimum rates in Indiana are as a rule too low. Mr. Robb also expressed the idea that present practices and rates for farmers' lines would have to be revised.

In the discussion F. A. Brown of South Bend, Ind., presented data to show that his company was losing money on a farm line. On this line, with eight customers to the mile, the fixed charges and losses per month per customer were $2.09. To come out even the company would have had to charge 23 cents per kilowatt-hour. Its present rate is 7.5 cents per kilowatt-hour. Samuel B. Mott of Noblesville, M. DellPlain of Hammond, Thomas Donohue of Lafayette, E. J. Condon of Angola, L. B. Andrus of South Bend, Prof. C. Francis Harding of Lafayette and L. C. Spake of Chicago all spoke on minimum rural charges.

The discussion on merchandising, which was very lively, was started by a paper "Should Central Stations Sell Electrical Merchandise?" by Charles B. Hart of Fort Wayne. The majority agreed with the author who said: "Electrical merchandise should not be sold only by central-station companies; neither should the central-station company be expected to develop the use of electrical merchandise and withdraw from the sale of it. There may come a time when the contractor-dealer can fully and competently handle the sale of electrical devices. Although this may now be the case in individual instances, broadly speaking it is not so. Until that time the central station has its place in the merchandising field." There was also a feeling that new devices should be introduced by central stations and that central stations should sell at a profit.

The other papers presented were "Financing Utilities," by Alex Holliday, Indianapolis; "Policy with Reference to Service Extensions," by H. O. Gorman, chief engineer Public Service Commission, Indianapolis; "Public Policy in Utility Operation," by E. J. Condon, Angola, and "Power-Factor Correction and Relation to Electric Power Rates," by R. H. Carlton, Schenectady.

Mr. Holliday's paper showed the high costs of capital to various industrial and utility companies. His comment was that with the higher cost of money and of operation the only solution will be in increased charges to the consumers. Mr. Bryan of South Bend said he was trying to distribute his overhead by increasing the volume of his business. To this end he is increasing his advertising and new-business expense above any previous figure.

Mr. DellPlain suggested that since the central-station business was divided into two classes, competitive or power and non-competitive or residential, it would be possible to stabilize revenue by making rates that would get and hold the competitive business. These might take the form of rates with clauses to cover variable items of cost such as labor, fuel, etc.

Mr. Gorman's paper stated that jurisdiction over services rested with the municipality and could come to the commission only on appeal. This is said to be a reversal of attitude on the part of the commission. Moreover, the paper indicated that free extensions to an amount equal to three to five times the annual revenue from the extension would be required by the commission.

In the discussion there was serious disagreement with the policy granting such long free extensions, because it was contended that the average capital turnover for the entire plant is usually once in five years.

The topics covered by Mr. Condon's paper included consolidation of plants and use of larger units, rates, building plants at coal mines, water power and finance.

Mr. Carlton's paper, read by Mr. Patterson, gave the comparative characteristics of various types of synchronous apparatus for power-factor correction.

Officers elected for the ensuing year are: President, P. H. Palmer, general manager Indiana Railway & Light Company, Kokomo; vice-president, F. J. Haas, Evansville; secretary-treasurer, Thomas Donohue, Lafayette; executive committee, T. A. Wynne, Indianapolis; S. W. Greenland, Fort Wayne; E. M. Walker, Terre Haute; E. J. Condon, Angola, and C. O'B. Murphy, Indianapolis; advisory committee, J. W. Robb of Clinton, Thomas English of Muncie and M. DellPlain of Hammond.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Changes in Street-Lighting Contract Rates. — The Missouri Public Service Commission held in a case affecting the Edina Electric Light Company that it is not its policy to change street-lighting franchise contract rates whenever it is reasonably consistent to avoid such action.

Purchase of Energy Suggested.— Where the generating plant of an electric utility in a small community was in need of rehabilitation and the public requested twenty-four-hour service, the Illinois Public Utilities Commission suggested that the plant be discarded and energy acquired from the lines of an adjoining interurban railway. This was the disposition of a case relating to the Bement Electric Light & Power Company.

Liability on Guarantees.—The California Railroad Commission held, in a case relating to the Coast Valleys Gas & Electric Company, that the mere fact that a company may be liable upon certain guarantees which it disputes will not prevent the commission from approving an issue of bonds where the funds of such issue are necessary to enable it to make extensions and improvements beneficial both to the utility and the patron.

Continuing Service. — In deciding a case relating to the Vandalia Electric Light Company the Missouri Public Service Commission ruled that an electric utility, having suffered the loss of a consumer permitting the rendition of continuous service for a reasonable return, is permitted to exact a surcharge of 10 per cent on all bills, except municipal accounts, that continuous service may be maintained rather than furnish non-continuous service against the desires of the consumers, said surcharge permitting of an income of 6 per cent for return and depreciation.

Extension in the Bronx.—The New York Public Service Commission, First District, has announced a decision on the complaint of Frank Rossomagno against the Bronx Gas & Electric Company as to alleged refusal to furnish electric service. The company refused to furnish electric service to the complainant's residence, located about 700 ft. distant from the company's nearest wires suitable for domestic lighting, unless the complainant would deposit in advance the sum of $136.90, a part of which would be refunded to him monthly or otherwise on the basis of his current bills. In the opinion of the commission, the extension desired was reasonable and accordingly it directed the company to extend its wires so as to supply with electricity the premises of the complainant upon the deposit by him of 50 per cent of the reasonable cost of the extension, to be refunded on a basis of one-half of his current monthly bills until the entire amount of the deposit is refunded.

Deferred Depreciation. — The Utah Public Utilities Commission discussed provision for deferred depreciation in a decision concerning the Bingham City Municipal Corporation. It said in part: "No depreciation fund has been created, and the property has wasted away through various causes until at the present time the testimony of the city manager is that depreciation of the property has reached 80 per cent. It develops that expenditures for repairs and replacements were not enough to maintain the plant in efficient operating condition. The policy from the beginning has been to extend rather than maintain the plant, and, as stated before, the utility now finds itself in a condition where no funds are available for replacements. A sound public policy demands that a company should be in a position at all times to replace worn-out, inadequate or obsolete property. . . It appears to the commission that if mistakes have been made in the past by such utility through a failure to set up proper depreciation reserves, public policy demands that such mistakes should be quickly rectified and the utility placed upon a sound basis. We do not feel that a utility should be permitted to earn a sum sufficient in one year to correct evils where depreciation was ignored. It will therefore be necessary, to insure the continued operation of the property, that a substantial sum be set up each year to cover past depreciation and also depreciation which will accrue in the future. We have to determine, in the first place, how large a depreciation reserve the public should properly create and maintain, taking into account the age and physical condition of the property, and for this purpose the valuation of the property as submitted by the city manager is accepted. In general a plant situated as is this one will be on a proper basis of depreciation reserve if the average life of the property is placed at twenty years, and if, therefore, a 5 per cent reserve is established. City Manager Roskelley accepted this basis for depreciation of the plant in question. But a reserve fund established now on the basis of 5 per cent of the present value of the property obviously will not be sufficient to overtake the depreciation before the plant is worn out. It will, in fact, provide only for current depreciation, if the theory of twenty years' life for the property is correct. The city manager estimates that 80 per cent depreciation has already occurred, but even if we assume 50 per cent depreciation to date, it will require 5 per cent reserve for ten years to care for past depreciation. This 5 per cent and a like amount to cover current depreciation should, it continued ten years, place the property in good physical condition."

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Engineers' Society of Milwaukee.— Dr. Edgar Kidwell gave an illustrated talk on "The Physics of Boiler Circulation" at the meeting of the society held on Sept. 17.

Electric Hoist Manufacturers' Association.—Sept. 26 is the date set for the next meeting of this association, which is to be held at 9 West Fortieth Street, New York City.

The Synchronous Club of Los Angeles—N. E. Brown of the United States Electrical Manufacturing Company spoke on "The How and Why of Electric Motor Manufacture" at the Sept. 9 meeting of the Synchronous Club of Los Angeles.

Electric Club of Chicago.—The first of the club's meetings at the Elks' Clubhouse was held on Sept. 16 with John J. Garrity, general superintendent of police for the city of Chicago, as speaker. Joseph Vranach has been appointed chairman of the entertainment committee and Joseph U. Heuser chairman of the reception committee of the club.

A. I. E. E., Panama Section.—A general discussion of 220-kv. power transmission occupied the attention of this section of the American Institute of Electrical Engineers at its Sept. 6 meeting. Different speakers took up the subjects of transmission, power plants, operating difficulties, switching equipment and telephone interference as related to high-tension operation.

Cleveland Engineering Society.—At a meeting of the society, with local sections of national societies, on Aug. 9, O. M. Smart, trade commissioner of the federal Department of Commerce, delivered an address on "Commercial Conditions in Europe," much of it pertaining to possibilities of hydroelectric power as developed in the Alps. Mr. Smart recently completed a survey of hydroelectric development in Italy from the standpoint of American investments. This development, which has been under consideration for years, was necessitated during the war because of the scarcity of coal. Conrad Hibbeler, district representative of the Mercury Manufacturing Company, delivered an address, illustrated by moving pictures, on "The Trackless Train for Moving Materials." W. E. Pease, chief engineer of the Cleveland & Youngstown Railway, gave an illustrated talk on the engineering problems of Cleveland's rapid-transit development. Dr. Willis A. Moore, president of the National Industrial Speakers' Bureau, spoke on "Doing the Impossible."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Signal Corps School.—A school to be known as the Signal Corps School has been opened at Camp Alfred Vail, New Jersey. This school will be considered as only a temporary one until the needs of the army for Signal Corps schools shall have been definitely determined and approved by the War Department.

Floodlighting for Hartford Tower.—Plans are being prepared for floodlighting the tower of the new building of the Travelers' Insurance Company at Hartford, Conn., one of the highest structures in New England. Thirty-six 400-watt and eight 250-watt projectors will be installed in the coming fall. The State Capitol dome is regularly floodlighted at Hartford, and the installation now planned for the Travelers' building will be the second of its character in that city.

Cleveland Municipal Plant Needs More Funds to Meet Demands.—W. E. Davis, light commissioner at Cleveland, Ohio, recently stated that if the municipal light plant is to meet the demands of residents asking for service, at least $500,000 more must be appropriated to be used in making extensions. When $2,000,000 was appropriated for enlarging the plant it was thought that a sufficient amount would remain for making the extensions, but the price of materials became so high that almost the entire amount was spent on the plant itself.

National Safety Council Congress.—A large collection of commercial and non-commercial safety guards, appliances, devices and accident prevention data will be shown at the exhibit to be held at Gray's Armory in Cleveland, Ohio, Oct. 1 to 4, inclusive, in conjunction with the eighth annual safety congress of the National Safety Council, it is announced at the headquarters of that organization in Chicago. The exhibit will be given under the auspices of the National Safety Council and the Safety Institute of America. An unusual shop-lighting exhibit will be conducted by the National Lamp Works of Cleveland, to which has been assigned the entire stage of the armory. This company will show a shop in operation, with three lighting installations, one poor, one mediocre and one ideal from the point of view of safety engineering. The light will be flashed on and off alternately while the advantages and defects of the different systems will be explained. This exhibitor will also show a model office and model drafting room with indirect light installations.

Water-Power Resources in France.—A French government census shows that the total capacity of the natural waterfalls of France is 9,000,000 hp. Of that total 750,000 hp. was utilized before the war and about 500,000 hp. has been put into operation since 1914. The Chamber of Deputies is now discussing a bill regulating the cession of water-power privileges which, it is hoped, will facilitate the utilization of the remaining 7,750,000 hp.

Electric Vehicle Exhibits at New York Electrical Exposition.—Practically every make of electric passenger car and electric motor truck, including the small industrial trucks, will be exhibited at the Electrical Exposition of 1919, opening in Grand Central Palace, New York, on Sept. 24, for its customary ten-day run. In addition there will be numerous displays of the various accessories applicable to the electric vehicle, from batteries to decorative lighting.

Seattle Project.—Development of the Skagit River power project will be one of the first recommendations of C. B. Fitzgerald, Seattle's newly elected Mayor. Mayor Fitzgerald believes that to an engineer who has specialized in hydroelectric construction should be given the direction of this project. He says that the city engineer's office is overloaded with municipal work and that City Engineer A. H. Dimock should be relieved of the additional burden of the Skagit development work. A conference of city officials is to be held in the near future to discuss the Skagit project and recommendations will be made at that time.

Consumers Consent to Rate Advance.—All but two consumers of the Amity (Ore.) Light & Power Company have consented to any increase in rates which the Oregon Public Service Commission deems just and equitable to both consumers and the company. J. A. Rubel, president and manager of the company, recently informed the customers that it would be necessary to advance rates or suspend operations, for the reason that present expense of conducting business far exceeded revenue. Rather than face discontinuance of the service, the consumers rallied to the relief of the company and sent in a memorandum consenting to an advance.

Public Works Movement in Kentucky.—George W. Hubley, consulting and advisory engineer, Louisville, Ky., has accepted the tender by the Engineers and Architects' Club of Louisville of the chairmanship for Kentucky of the National Federation of Engineers, Architects and Contractors' Association as organized in Chicago, April 25, 1919, for the purpose of directing a campaign for the creation of a National Department of Public Work. The Engineers and Architects' Club of Louisville has also requested a number of prominent and representative engineers throughout the state to serve in their respective congressional districts as a general state committee in support of the movement.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Operation of a Defective Switch.—An electric merry-go-round operator, having no experience with electricity and no knowledge that the switch is defective and likely to close the circuit by its own weight so as to start the machine while he is making repairs, is not chargeable with knowledge of the danger, according to the Commission of Appeals of Texas (213 S. W. 931).

Damage to Riparian Lands.—Thirty dollars an acre for the 12 acres of plaintiff's meadow land rendered worthless by flooding caused by defendants' damming of a stream flowing out of the lake on which the meadow land was situated, the Supreme Court of Michigan has held (173 N. W. 339), is necessary to compensate plaintiff for his damages past, present and future.

Defective Switch Caused Death.—In an action for the death of an inexperienced servant, caught by cog wheels of an electrically driven merry-go-round, which started because of a defective switch while he was making repairs, whether the proximate cause of death was due to defendant's negligence, and whether deceased assumed the risk incident to a defective switch, the Commission of Appeals of Texas held to be questions for the jury (213 S. W. 931).

Contract to Furnish Electric Energy.—A contract by which an electric company agreed for a term of twenty years to furnish to a town, through a transmission line to be built by the town and connected with the company's line, "all the electricity and current that shall be desired by the town or by its patrons along its transmission line," to be paid for by meter measurement, but by which the town assumed no obligation to purchase any definite quantity of electricity, has been held by the District Court, N. D., Iowa, C. D., to be void for lack of mutuality (257 F. 819).

Storage Reservoir.—A dam built across a creek channel from bank to bank to impound water comes within the exception noted in Section 3444, Revised Statutes of 1913, which provides that "a reservoir constructed for the purpose of holding water back and raising it in order that it may be applied to lands of a higher level or given a greater head for power shall not be considered a storage reservoir." An upper riparian owner who constructs such dam is not liable for damages arising from the breaking thereof, unless the dam has been negligently constructed or maintained, according to the Supreme Court of Nebraska (173 N. W. 593).

Men of the Industry

Changes in Personnel and Position—Biographical Notes

C. F. Millar, for several years local manager of the Montpelier & Barre Light & Power Company at Barre, Vt., a property operated by Charles H. Tenney & Company of Boston, has resigned to represent the granite interests of George Straiton in the Barre district.

Elbert G. Allen, who has been appointed advisory engineer of the Stone & Webster organization, was educated at the Massachusetts Institute of Technology. He received the degree of B.S. in mechanical engineering in 1900 and E.E. in 1901. From 1901 to 1907 he was employed by Stone & Webster on various kinds of engineering work at Boston and in the Puget Sound district, having his headquarters at Seattle the latter part of that period. He was superintendent of construction for Stone & Webster at Dallas, Tex., in 1907, and then returned to the Boston office, where he has since had change of much of the important steam and electrical work done by the company. In 1918 he was made assistant engineering manager. His new appointment as advisory engineer will leave him free from routine matter so that he can devote his entire time to consultation and special problems.

F. D. Egan, formerly works manager of the Pittsburgh Iron & Steel Foundries Company, has accepted a position in the general engineering department of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa., where he will devote his time to the development of electrical apparatus for steel-mill application. Mr. Egan's experience with electrical apparatus as applied to steel mills has extended over a number of years After graduation from Grove City College he went to work in the inspection department of the Westinghouse Electric & Manufacturing Company. After a little more than one year he accepted a position with the Carnegie Steel Company, Carrie Furnaces, where he served as assistant chief electrician. This position he resigned to join the electrical engineering force of the National Tube Company and was shortly promoted to be assistant superintendent. In 1911, at the end of the construction period that lasted for four years, Mr. Egan left the National Tube Company to accept the position of electrical engineer with the Pittsburgh Crucible Steel Company during the construction and operation of its Midland Works. In the latter part of 1917 he left the Crucible Steel Company to enter the employ of the Pittsburgh Iron & Steel Foundries Company of Pittsburgh as works manager and to take charge of that company's war work. He served in that capacity until he joined the general engineering department of the Westinghouse company. Mr. Egan is a member of the iron and steel committee of the American Institute of Electrical Engineers, a member and past-president of the Association of Iron and Steel Electrical Engineers and a member of the Iron and Steel Institute.

G. C. Estill, formerly chief engineer of the Cumberland County Power & Light Company at Portland, Me., has been appointed general manager for Roy Rushton, receiver of the Montgomery (Ala.) Light & Traction Company. Mr. Estill is a native of the South, born near Lexington, Ky. In 1902 he was graduated from Kentucky University with the degree of A. B. and in 1907 from Cornell University with the degree of M.E. From October, 1907, to July, 1908, he was employed by the

G. C. ESTILL

Nashville (Tenn.) Railway & Light Company as foreman of bonding. He was next associated with the Birmingham (Ala.) Railway, Light & Power Company, first as motorman and conductor, and later as operator in powerhouse, meter and line departments. In May, 1910, he was advanced to assistant engineer of the company, which position he held until made chief engineer of the Cumberland County Power & Light Company in August, 1915. Mr. Estill's appointment as general manager of the Montgomery company was dated July 12, 1919.

Philip C. Jones, who contributed the article published in the Aug. 9 issue of the ELECTRICAL WORLD on "Motor Testing in Industrial Plants," is assistant electrical engineer of the Goodyear Tire & Rubber Company at Akron, Ohio, instead of electrical engineer with the Goodrich Tire & Rubber Company, as mentioned in connection with that article. Mr. Jones has made a thorough study of motor operation, and the article referred to deals with problems of selecting motors of correct size to offset their increased cost and with other problems of a similar kind connected with motor operation in industrial plants.

Louis H. Egan, who was assistant general manager of the Union Electric Light & Power Company, St. Louis, has been elected one of its vice-presidents. Mr. Egan was graduated from the Sheffield Scientific School of Yale University in 1904 and for about eighteen months thereafter worked for the Algoma Steel Company, Sault Ste. Marie, Ontario, as an electrician's helper. He then entered the central-station field and for the next five years worked in various capacities for the Edison Sault Electric Company and for the companies affiliated with the Detroit Edison Company in various engineering and sales capacities, finishing up that period as division manager for the Eastern Michigan Edison Company. From 1910 until 1916 he was general manager of the Kansas City Electric Light Company and in November, 1916, became affiliated with North American Company properties in St. Louis. Mr. Egan was first appointed general manager of the Electric Company of Missouri and after that company was combined with the Union Electric Light & Power Company he was made assistant general manager of the combined properties. Mr. Egan has also served as vice-president and general manager of the St. Louis County Gas Company, which position he still retains.

Obituary

Henry A. Reed, who had been president of the Bishop Gutta Percha Company for fourteen years, died Aug. 23. On Feb. 11 of this year Mr. Reed celebrated his ninetieth birthday. He was born in Carmel, N. Y., and became identified with the electrical industry in 1849 as a telegraph operator and was connected with the telegraph business until 1885, when he was made secretary of the Bishop Gutta Percha Company. In 1905 he was elected president of that company. Mr. Reed was one of the pioneers in the design of high-tension cables intended to be used underground.

William H. Austin, who died on Aug. 14 at his home in North Weymouth, Mass., was born in Lowell eighty-two years ago. Mr. Austin was one of the pioneers in the electrical business. In 1881 he acted as superintendent of the work of installation of the electric light plant in Brockton. He was then associated with Thomas A. Edison and afterward with the old Edison Company of Boston. Later, he was with the General Electric Company in Lynn, and when that company consolidated with the Thomson-Houston Company, he went to the Holtzer-Cabot Company in Boston, where he remained until he retired from active business pursuits five years ago.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

ORDERING OF CROSS-ARMS AND PINS FOR FALL IS GOOD

Prices of Pine Arms Have Gone up 15 per Cent and Those of Fir Arms 10 per Cent This Month— Wood Pins Are Firm

In anticipation of fall construction and winter maintenance needs there has been a good volume of wooden cross-arm and pin ordering to date. There is, however, considerable room for improvement if stocks of certain grades of fir arms are to be accumulated and regular stocks of woodenware maintained.

Prices on pine cross-arms advanced 15 per cent on Sept. 15. At New York warehouse 6-ft., four-pin and six-pin yellow-pine arms cost $78.10 in less than 1000-linear-foot lots, and 75 per cent long-leaf arms $89.64. In lots of more than 3000 linear feet these respective prices will be $65.08 and $74.70. Deliveries are good. Fir arms went up 10 per cent on Sept. 1, with one grade ranging from $92.04 to $110.45 for the same size and quantities as above with mill deliveries, and another grade $51.19 in carload lots and two to three months' deliveries. On pins prices have remained rather steady, and no change is looked for in the near future. Locust pins, 1½ in. by 9 in., are quoted at $45, $40 and $24 per 1000 in lots from less than 250 pins to 5000 and over.

INCANDESCENT LAMP BUSINESS IS INCREASING

Present Supply Adequate for Fall Demand, Which with the Removal of All Restrictions Should Be Considerable

The electrical industry can congratulate itself that incandescent-lamp manufacturers are unusually well prepared for the fall trade this year and that there is every probability that the central-station peak-load season will be passed without the occurrence of a shortage in popular sizes and types. Since the armistice manufacturers have devoted much energy to enlarging their facilities for production, and stocks of lamps are generally in fine shape. Contracts for next year's supplies are being taken with the confident expectation of meeting requirements punctually, and provision is being made to utilize the benefits of mass production in getting out the newer types and sizes as fast as these are sought in quantity by the trade.

The restrictions on lighting which were brought about by the war are now but a memory, and there is little evidence that the economies instituted for the sake of fuel saving will have a permanent effect on the liberal use of light. Daylight saving will soon be over, certainly for 1919. Central-station rates for lighting did not rise sufficiently during the war and armistice periods now terminating to discourage seriously the use of electrical energy for this class of service along expansive lines, once the need of curtailment was removed. Business establishments are studying the relation of efficient lighting to increased sales or production, and widespread prosperity encourages the use of improved fixtures and portable lamps in the home, some of these being of exquisite design and workmanship, well adapted to the most exacting requirements of interior decoration. Floodlighting is being taken up more vigorously from the commercial and civic standpoints, and the routine users of electric lamps, like the hard-pressed street railways and the prosperous automobile fraternity, are buying in large quantities. Thus the demand bids fair to increase considerably as the winter comes on, and it is not certain that all manufacturers will be able to maintain stocks through the cold weather, if general industry grows.

1918 FUSE PRODUCTION ESTIMATED AT 24,000,000

Present Indications Are that 1919 Output Will Not Exceed 75 per Cent of Previous Year's Figures Unless Unexpected Building Boom Occurs

Fuse production has in recent years reached enormous totals. This business is one of the fastest growing in the industry. Particularly is this true of the renewable-fuse business.

No absolutely accurate detailed figures on fuse production are available, but an estimate by the staff of one of the largest and best informed producers in the country places the fuse output of the United States for 1918 as follows:

Automobile fuses	7,000,000
Renewable fuses	8,000,000
Standard fuses	9,000,000
Total	24,000,000

This estimate is for all of the fuse manufacturers in the United States.

The indications are that the output for 1919 will not exceed 75 per cent of the above total, unless an unexpected boom occurs in building this fall.

ALARMING SHORTAGES IN WIRING SUPPLIES DEVELOP

Stocks of Conduit Wire, Sockets, Armored Conductor, Etc., Melt Before Buying Demand, with Big Building Movement Ahead

A most alarming shortage of fast-moving electrical supplies is apparent everywhere. Each week the reports to the ELECTRICAL WORLD show conditions as a whole to be worse. There are, of course, exceptions. In Chicago, for instance, the jobbers anticipated labor disturbances at the steel mills and placed orders to tide them over what might be low production periods. As a result there will be good local stocks there of rigid conduit to take care of the building demand when the building trades labor troubles shall have gone by.

It is also true that on flexible armored conductor and metallic flexible conduit the factories are making somewhat better deliveries. Stocks, however, are low.

Wire deliveries are holding about the same, but local stocks, especially in smaller sizes, are very low. Rubber-covered sales are easing up slightly, but still manufacturers are terribly behind on orders.

Rigid-conduit shortages have developed only within the past few weeks. On the Pacific Coast jobbers and local distributers have changed in a few weeks from nice stocks to a condition of being considerably oversold.

Lamp sockets are another item in which there seems to have developed a national shortage.

With what seems to be a building boom just started in a number of sections of the country, these shortages are

really serious. In some lines it is apparent that the trouble is lodged in the insufficiency of manufacturing plants. The demand in these lines had been light for two years or more, and the manufacturers, naturally, had taken no steps to increase capacity.

In other lines, however, the trouble can be directly traced to hesitancy on the part of both jobbers and manufacturers to stock up in anticipation of a building demand. Such ultra-caution at a time when it was highly apparent that building must proceed will undoubtedly prove expensive to manufacturer and jobber alike in lost orders because of no stock.

NEW HEATING DEVICE SCHEDULES ARE IN EFFECT

Orders Taken Prior to Aug. 20 Can Be Shipped Up to Oct. 20 at Old Prices—Bookings Not Now Billed Take New Lists

The schedule of prices under the heating device patent license becomes effective to-day, Sept. 20. This is the first time since August, 1918, that the license schedule prices have been advanced. In a good many instances holders of licenses, it is known, have lists that are in excess of the schedule list. In some of the cases the manufacturers are granting larger discounts, so that the net price is virtually the same in both instances. In other cases the manufacturers have felt that the new schedule of prices did not allow a margin of profit sufficient to do business and for that reason have gone to list prices which are somewhat higher still. Thus, while the schedule calls for $6.75 as a list for the standard 6-lb. iron, there are some manufacturers who have listed these at $7 and $7.25. The manufacturers, it is generally understood, have felt that the new list prices should have been higher than they are. The holders of the patent, however, have let it be known that while they recognize that the new list prices do not allow for a large margin of profit, still they could not advance the prices without, as in the case of flatirons, going to $7, in which case the profit, it was felt, would be of a size that is unwarranted at the present time.

Owing to the conditions of supply and demand and also more particularly of labor, the licensors at this time made a change in the customary rule preventing billing at old prices after the schedule went into effect. Under the terms of the present change in the scheduled prices manufacturers may bill up to Oct. 20 orders received prior to Aug. 20 at the prices then in effect. Orders taken after Aug. 20, however, could be billed at the old prices if shipped prior to Sept. 20. All orders booked from now on must be billed at the new prices.

SECOND-HAND APPARATUS MARKET LOOKS ENCOURAGING

Last Two Months' Sales Large and Still Better Fall Buying Is Anticipated—Prices Expected to Advance

During the past two months the condition of the used apparatus market has improved to a marked degree and a large volume of business has been transacted. This state of the market is not localized, but is characteristic of the whole country. Inquiries for export are in a healthy state and point to a satisfactory market in that direction.

The power-generation apparatus market is in particularly good shape in respect to demand, although the supply in some sizes is very low. The heaviest demand is reported for steam-driven sets of from 50 kw. to 300 kw. capacity, with special emphasis on alternating-current turbine sets. Those with capacity around 100 kw. and 200 kw. for moderate-sized industrial plants are reported so scarce in the market that delays of twenty-four hours in placing an order are sufficient to lose all chance of securing the set. Stocks of generating apparatus are as a whole quite low, and there is less available material for sale than in pre-war times.

Prices have been holding steady all summer and are given as from 50 to 70 per cent of new apparatus prices as a fair average. They rose in some cases to above first-hand apparatus during the war, but are now back to about pre-war levels.

The used-motor market is also active. Lengthening shipments of the larger size motors from manufacturers are a cause for boosting sales of the second-hand dealer, and as the fall comes on these dealers are looking for even an increased business. The used-motor trade seems to expect manufacturers to advance their motor prices this fall, and this of course would permit seconds to do likewise. They base their expectancy on increasingly longer shipments of new material, which appear to go hand in hand with upward prices. An advance of 10 per cent on new motors would permit seconds to advance their prices about 25 per cent. Among manufacturers, however, there is no assertion that prices will advance this fall, but in several quarters this rumor continues to persist.

Small used motors up to 50 hp. are moving in good volume. In New York City direct-current motors of course have the biggest call, but for work outside the city the alternating-current types are in heaviest demand. This condition varies throughout the country because of the different kinds of industry carried on in different localities. Prices on the small motors run from 25 to 50 per cent below new motor prices, with sizes from 1 hp. to 10 hp. holding closer to the 25 per cent figure. Stocks are generally good in both alternating-current and direct-current equipment.

Transformers are enjoying a good demand from central stations which want quick delivery and from contractors who want service on construction jobs. Some rather large sales of used transformers have recently been recorded.

Dealers report a rather unsatisfactory condition in the used-boiler market, not because of any lack of demand but because of local regulations in some communities. They feel that hardship is imposed in ordering 15 per cent reduction in pressure on a second-hand boiler which in the first instance may have been in commission only a few weeks.

Taken as a whole, the second-hand apparatus business is in good shape, and optimism is strong for a still better fall season. Dealers are buying up motors and smaller generating sets whenever they are available and are having little difficulty in disposing of present stock of that class of material.

CHRISTMAS-TREE OUTFIT STOCKS RAPIDLY VANISHING

Demands Being Met Temporarily, but Shortage Is Feared on Account of the Lessened Amount of Production

Stocks on small fancy lamps and special lighting equipment for the Christmas trade have been depleted recently, and distributers doubt if they will be able to supply the demand six weeks from now, owing to a shortage of filament wire at the manufacturing plants. The principal trouble seems to be that labor is not producing anywhere near up to the standard, although the wage scale is much higher than ever before. One distributer expects to be able to handle all orders placed within a month so far as his stocks last, but cannot promise anything beyond that time.

The small tungsten lamps used on Christmas trees are all manufactured in this country. Deliveries, however, are bad. As an illustration of how the business is affected, one distributer has received less than 8000 tungsten lamps on an order of 50,000 placed in the spring and has been advised that there will be no more forthcoming this year. Of the three sources of supply it is reported that two already are sold up.

Manufacturers report that their shops are working nights in order to take care of present orders on hand and that

they are increasing their forces wherever possible. Sales, orders on hand and inquiries to date indicate that the demand this year will be at least 50 per cent more than that for the corresponding period last year. It is definitely stated that prices will remain practically the same as last year throughout this season unless forced up by labor troubles.

Distributers are endeavoring to use better packing methods, and one firm is packing fifty units in what is termed its standard package. These are of a convenient size and easy to handle.

Christmas-tree lighting sets for 110-volt circuits are in considerable demand. Stocks are short but every attempt will be made to keep up with orders.

METAL MARKET SITUATION

Heavy Buying of Copper by Large Consumers from Second Hands with Large Stocks

The copper market, as far as the producers are concerned, continues in a quiet state. The second hands are the ones who are providing the interest in the market, as much more new copper is being found in their possession than it was heretofore thought existed. Producers of the metal are carefully watching the operations of these sellers and are beginning to take counsel among themselves as to the outcome of the situation. Some of the largest consumers of copper have very recently purchased heavily from the seconds, it is reported, for spot delivery.

The outcome may lead producers to consider a lowering of price and it has also been reported that first hands have already accepted orders at 23 cents a pound for September shipment and set a price of 23.50 cents on November and December shipments. In each case this is a concession of ½ cent over their prices held for several weeks. The seconds, on the other hand, are selling copper at 22.12½ cents for September and October, and 22.25 to 22.50 cents for the last two months of the year, and they are selling the metal, too, in large quantities to all classes of consumers.

The labor situation is having a quieting effect on the metal market and on trade in general. Rumors persist that the threatened steel strike will be postponed.

Lead has advanced ¼ cent to 6.25 cents New York. There has been a good consumption recently, and the market is considered firm.

Zinc demand is only fair in the domestic market, with little business reported for the last of the year. Prices are slightly off to 7.55 cents.

Scrap brass is off ½ cent to ¾ cent. The offering of around 75,000 tons of brass by the government salvage boards is probably responsible for the lighter interest of consumers in the outside market.

NEW YORK METAL MARKET PRICES

	Sept. 9	Sept. 15
Copper:	£ s d	£ s d
London, standard spot	100 10 0	101 0 0
	Cents per Pound	Cents per Pound
Prime Lake	23.00	22.62½
Electrolytic	22.25 to 22.37½	22 12½
Casting	21.62½	21.50
Wire base	26.00	26.00
Lead, trust price	6.00	6.25
Antimony	8 62½	8.50
Nickel, ingot	41.00	41.00
Sheet zinc, f. o. b. smelter	10.50	10.50
Spelter, spot	7.70	7.55
Tin	56.25 to 56.50	56.50
Aluminum, 98 to 99 per cent	32.00 to 33.00	32.00 to 33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	19.00 to 19.50	19.00 to 19.50
Brass, heavy	10.75 to 11.25	10.00 to 10.50
Brass, light	9.00 to 9.25	8.50 to 9.00
Lead, heavy	5.00 to 5.10	5.00 to 5.10
Zinc, old scrap	4.75 to 5.00	4.75 to 5.00

THE WEEK
IN TRADE

THE increasing scarcity of electrical goods is becoming very serious. Shortages exist in local stocks of conduit of all kinds, weatherproof and rubber-covered wire, especially in the smaller sizes, silk lamp cord, flexible armored conductor, sockets, fuse plugs, house meters and standard porcelain.

Range sales are slow in New England and on the Pacific Coast as a result of the recent advance. The Middle West, however, reports good sales. An excellent demand for distribution-type transformers has developed in the South. The oil boom in the Southwest has helped insulator sales.

Building seems to be going ahead rapidly, but a warning comes from the Northwest, where building is once more being restricted. As a result, schedule material sales in that region are off perceptibly. This is made up to some extent by the big sales of electric heating and cooking devices as a result of the Seattle gas strike.

Prices generally are steady. Glass insulators are up and fan prices have been withdrawn. Locally prices vary somewhat, depending on the condition of supply and demand.

NEW YORK

Demands of the building trade and rehabilitation work have kept electrical material running at a high pitch. Supply jobbers report conditions satisfactory. Manufacturers' prices are undergoing few changes.

Slow freight and inability of producers to supply the demand of some classes of material are proving quite a factor in the market. Factory shipments of flexible armored conductor have been much better in the last couple of weeks, but entire orders are not being filled yet. Express shipments are being resorted to.

Conduit junction boxes and fittings are going in fine shape, principally in the smaller sizes, however. Heavy orders on the mills are running them to capacity, and in some quarters rigid-conduit production for 1919 has been booked up and prices on fittings withdrawn.

GLASS INSULATORS.—Hemingray insulators advanced 10 per cent on Sept. 1, but the old prices are still being quoted from New York warehouse—No. 19 and No. 20 from $8.04 per 100 by the hundred to $5.92 for c.l.l. Brookfield insulators advanced 10 per cent on Sept. 6, and prices from the mill on No. 36 and No. 38 are $5.77 per 100 by the hundred to $5.27 in c.l.l.

RIGID CONDUIT.—Stocks of small sizes are getting low, with some jobbers and shipments lengthening. In other cases stocks are good. One-inch black is quoted from $130.39 to $138.89 per 1000 ft. in 1000-ft. lots.

FLEXIBLE ARMORED CONDUCTOR.—Deliveries to jobbers are still behind, but factories are making better shipments. No. 14 single strip is selling for $80 per 1000 ft. One jobber is using express deliveries from mill to fill his orders.

INSULATION.—Apparatus manufacturers are ordering in light volume at present. Prices have remained steady for several weeks, and no rise is anticipated. Export inquiries are better.

TAPE.—A good price for friction tape seems to be 40 cents a pound, with rubber tape at 47 cents.

WIRE.—All bases are holding steady. Stocks of smaller sizes of rubber-covered wire are spotty and factories are as a rule much behind on shipments. The demand is heavy. The price of No. 14 is frequently given as $11.50 per 1000 ft. in 1000-ft. lots, with one assertion that it could be bought for $10.50.

LAMP CORD.—A good market is the rule with some prices hard to find on account of over-ordering of production. No. 18 twisted can be purchased by contractors for $17.10 and reinforced for $29.10. Silk cord is almost out of the market.

CHRISTMAS-TREE OUTFITS.—Sales have been good, but further factory output for this year has been greatly curtailed by short supplies of lamps and of cotton parallel cord. Prices hold near those of last year.

FANS.—Some manufacturers have withdrawn fan prices as of Sept. 1 on all but very small orders. Other producers have set Oct. 1 as the date. Jobbers' stocks have been pretty well cleaned out.

STORAGE BATTERIES.—Battery prices have remained steady, but one manufacturer has increased prices on rubber parts 10 per cent and decreased prices on lead parts the same amount, effective Sept. 15. Demand is high, and labor conditions are slowing up factory deliveries.

CHICAGO

In anticipation of the agreement expected on Sept. 25 between the carpenters' union and the contractors business conditions in Chicago have taken on a brighter outlook. Jobbers and contractors are receiving inquiries, although no large increase of orders has yet been made. Construction is coming back to life again, as is shown by building permits for over $1,800,000 taken out in the last week. Moreover, more than $2,000,000 of construction was proposed, including a one-million-dollar tool-factory addition to Whitman & Barnes' plant. Quite a good deal of electrical construction is being done by the Byllesby company in the West to take care of the congestion caused by the flocking of people to the new oil fields. An Indiana concern is constructing a high-tension line. The Mutual Paint Company will put up a plant in St. Paul to cost $150,000. New buildings in Enid, Okla., during the past year are estimated at $3,000,000. The Illinois Malleable Iron Company will build a half-million-dollar plant at Louisville, Ky. The upper peninsula section of Michigan is undergoing the severest drought of many years. Water-power plants are suffering acutely from it, and those with no steam reserve are contemplating the purchase of a number of small units.

INSULATORS.—Business in high-voltage insulators has been very good, although the orders have been spasmodic. Construction on systems in the Western oil fields and on work in Indiana has taken the greater part of recent deliveries. Current prices are about $2.45 for the 10-in. suspension type, $1.80 on the 33,000-volt pin type, $2.10 on the 45,000-volt pin type, and $3.25 on the Hewlett suspension type.

RANGES.—Business is very good, the Chicago office of an Eastern manufacturer delivering 700 ranges during the week ending Aug. 30.

WASHING MACHINES.—The demand is still so good that neither manufacturers nor jobbers can fill orders. Shortage of wringers is holding back deliveries.

WIRE.—The demand for the smaller and medium sizes still keeps stocks at a low stage. Prices are firm, rubber-covered selling at a 30-cent base, weatherproof ranging from 28 to 32 cents, and bare wire averaging about 28 cents.

CONDUIT.—Anticipation of troubles in the steel industry led Chicago jobbers to place orders some time ago which are being delivered now in good style.

CONDUIT FITTINGS.—Stocks of fittings are fair and prices are firm. The ½-in. coupling is quoted at 7 cents and the ½-in. elbow at 19 cents.

FLEXIBLE STEEL CONDUIT.—The demand is very good, and stocks are not up to normal. This has caused some local rises in price.

NON-METALLIC CONDUIT.—There is still a scarcity. Small and medium out-of-town jobs are consuming most of this material. The list price on ½-in. is about $30 per 1000 ft.

SCHEDULE MATERIAL.—Jobbers report that deliveries are still very slow. There is a marked scarcity of sockets.

FRICTION TAPE.—Stocks seem to be in good condition, with fair demand. Prices vary from 40 to 60 cents according to quantity for lower grades, and 72 cents per 100 lb. for the best grades.

LAMP CORDS.—Stocks are fair, and there is a good out-of-town demand. The price per 1000 ft. averages about $30 net.

INCLOSED FUSES.—Most jobbers have very good stocks, partly because large orders were placed during the war. The demand is normal, although less than it was last year. The price on a 3-amp., 250-volt fuse is 25 cents list; on the 100 amp. fuse, 90 cents list, with 40 per cent to 50 per cent off for standard packages.

FUSE PLUGS.—Stocks are very low under a fair demand. Prices are quoted at $47.50 per 1000.

BOSTON

Trade holds up extremely well in jobbing circles, and retailers in the electrical field note little falling off in the city of Boston on account of the police strike. Stocks of wiring materials are running lower, and collections are not quite so satisfactory. Prices hold firm, and new building outlay to Sept. 11 for this year totals $142,634,000, compared with $119,195,000 in the corresponding 1918 period. This exceeds all but two years since 1909. New projects include a twenty-four, a twenty and two ten-apartment houses at Portland, Me.; a six-story, 50-ft. by 160-ft. addition to the factory of Landers, Frary & Clark, New Britain, Conn.; an addition, to cost $150,000, to the New England Silk Company's factory and power plant at Westerly, R. I.; a 50-ft. by 125-ft. addition to the Duckworth Chain & Manufacturing Company, Springfield, Mass., and extensive additions to the plant of the General Wire Company, Palmer, Mass.

RANGES.—Sales continue mainly at the old prices, pending exhaustion of stocks. Dealers show little inclination to stock up at the new prices.

POLES.—Fair stocks of chestnut poles are on hand. The Western Union Telegraph Company was active in last week's market. Thirty-five-foot poles are quoted around $10 f.o.b. Boston.

CROSS-ARMS.—Standard ten-pin Washington fir arms are priced at $2. The demand is fair for four-pin and six-pin arms, with good stocks.

WASHERS.—These continue to arrive in carload lots but are soon distributed. Prices are steady, running around $145 for some makes.

WIRE.—Rubber-covered base price stays at 30 cents; weatherproof, from 29 to 30 cents; bare, 27 to 28 cents. No. 14 wire is running short.

CONDUIT.—The smaller sizes are getting scarce, despite the fact that much recent building construction started will not require pipe for six to nine months. One-inch black pipe is quoted at 16.4 cents per foot, ½-in. at 8.375 cents, and 3-in. at 73.82 cents, net.

COUPLINGS.—Seven cents each is asked for ½-in. couplings to 66 cents for the 3-in. size. Elbows, ½-in., are selling for 19.85 cents.

KNOBS, TUBES AND CLEATS.—These are getting very scarce, with increasing demand. Nail-it knobs are hard to get; price quoted is $16.50 per 1000, net. The 3-in. by 5/16-in. size of tubes sells for $5.25 per 1000 in barrel lots.

SOCKETS.—The supply is none too ample for current demands. Keyless, 30 cents; key, 33 cents, and pulls, 60 cents each, are typical prices. Manufacturers are exceedingly busy, and jobbers find it hard to build up stocks.

ARMORED FLEXIBLE CONDUIT.—The demand continues heavy, with little in sight, except where heavy advance purchase was made.

FRICTION TAPE.—Standard ¾-in. black tape is quoted at 42 cents per pound, with plentiful supply, this price being easier than for the last few weeks.

NON-METALLIC FLEXIBLE CONDUIT.—Fair stocks are in hand, and the demand is moderate. Prices show an easier tendency, ⅜-in. loom running around 3.5 cents per foot.

DRY BATTERIES.—Stocks are in good shape, with moderate demand. In barrel lots the No. 6 standard cell quotes around 32.9 cents, with 33.9 cents for ignitors.

ATLANTA

An active demand for all kinds of electrical material continues from all sections in the Southeast. The labor situation in the electrical field is quiet, and the only immediate disturbing element is the textile strike at Macon, Ga., which is attaining serious aspects. As a rule jobbers are buying liberally, covering their prospective late fall requirements and at the same time obviating delivery trouble later on. Contractors are busy on residence work and industrials, especially mill village lighting. Building is still expanding and assuming larger proportions. Reports from manufacturers and jobbers indicate a healthy condition of credits and collections, and the percentage of collections of accounts receivable is maintaining a high standard.

ARMORED CONDUCTOR.—Manufacturers state that trade is more active and business has picked up considerably this week. Factory shipments are better. Local stocks, on the other hand, are low. Prices are firm. We quote jobbers' price on No. 14 net, per 100 ft.: 2500 ft. to 5000 ft., $8.85. Five per cent cash ten days.

WIRE.—The scarcity of both weatherproof and rubber-covered at Atlanta is serious, and other distributing centers in the Southeast report like conditions. One manufacturer's base for weatherproof is 30 cents and rubber-covered 28 cents. We quote jobbers' price per 100 lb. on triple-braid, solid-conductor, f.o.b. Atlanta, on No. 4 weatherproof, 500 lb. to 1000 lb., $33.45; No. 10, same quantity, $36.45, net.

METALLIC FLEXIBLE CONDUIT.—The demand is fair this week and holding up well compared with the great activity of the previous few weeks. Prices have not changed lately. Shipments from factory on double strip are good, but deliveries on single strip are slowing up materially. On the whole, Southeastern stocks are in fair condition. We quote jobbers' price on double strip per 100 ft.: Coil to 1000 ft., ½-in., $9.80; ¾-in., $12.74; 1-in., $20.58. Five per cent cash ten days.

FARM-LIGHTING OUTFITS.—The market for these is quite active, and manufacturers and dealers report a substantial gain in volume of business. Factory shipments are improving.

CONDUIT.—The call for both black and white rigid is steady. Eastern promises of shipment are from four to five weeks, with longer deliveries in some instances. Local stocks generally are normal. We quote jobbers' price net per 100 ft.: 2500 lb. to 5000 lb., f.o.b. Atlanta, on black ½-in., $8.29; ¾-in., $10.99; 1-in., $16.52; 1¼-in., $21.99; 1½-in., $26.29; 2-in., $35.37; 3-in., $73.13.

TRANSFORMERS.—An excellent market exists for 2300-volt distributing type, especially from municipalities. There is a scarcity in a few of the smaller sizes, but otherwise stocks are well filled. Distributers are having some difficulty in getting shipments after they have left the factory. Manufacturers report more activity in power types.

PANELBOARDS.—Factory shipments on standard boards run into two weeks and for standard cabinets ten days. The volume of sales is quite satisfactory.

METERS.—Central-station requirements are heavy and the movement continues strong. Southeastern stocks are getting low. This condition is not pleasant in the face of slower factory shipments.

OIL CIRCUIT BREAKERS.—The call from industrials is good, especially the textile field. The most popular capacity is 200 amp. Stocks locally are well up to standard, with fair incoming shipments.

SEATTLE—PORTLAND

As a result of the gas strike in Seattle called on Sept. 6 central-station jobbers and dealers have done an enormous business in electrical household appliances and tableware. Sales of hot plates, percolators and toasters have been unprecedented, and at present stocks of these devices are low. In fact, hot-plate stocks are exhausted. The demand continues, and jobbers have secured all available stocks from nearby cities.

The three-day visit of the Pacific fleet to its home port and the coincident two-day visit of President Wilson has demoralized business in all lines. Industrial plants and stores closed for part of each day and buying has been extremely light. The strike of building trades, which began Sept. 2, still continues, and at present no hope is held out for an early settlement. Leading architects report they have been instructed to withhold all work on plans for immediate building until next summer as a result of the increasing cost and unsettled conditions. The port commission of Seattle has abandoned its building projects, involving several hundred thousand dollars, and the school building program, involving $4,500,000, authorized at a recent school election has been indefinitely postponed. Car shortage continues to interfere seriously with lumber shipments in the Northwest.

HEATING MATERIALS.—Some jobbers believe house-appliance business will show increased activity this fall and winter. Plans for one or two of the larger apartment houses proposed for Seattle provide for electrical stoves throughout.

SCHEDULE MATERIALS.—Demand has practically ceased since the first of the month owing to building trades strikes, and jobbers have had an opportunity to replenish stocks, which were running low.

SAN FRANCISCO

Week by week the demand for electrical staples has grown until the available stock has dwindled to a vanishing point and is overshadowed by huge back orders. The contributing causes are delayed rail shipments, disturbed factory conditions and, principally, the arrival of the long-delayed building boom, which is now climbing toward its peaks. The value of August building permits in the three principal California cities is: San Francisco $2,788,717; Los Angeles, $2,402,444; Oakland, $921,381. Labor conditions are fairly quiet with no local strikes. Collections are good.

SOCKET DEVICES.—Jobbers report unusually good orders for heating material covering hollow ware and industrial devices as well as the standard irons, toasters and disk stoves. The recent price advance has stimulated advance Christmas buying by dealers. Jobbers' stocks are low, but good shipments are on their way.

CONDUIT.—One manufacturers' agent reports that whereas he had a reserve stock of 150,000 ft. of a certain style three months ago, he now has back orders for four times that amount to be distributed along the Pacific Coast. The situation will become very serious should the threatened steel strike occur.

SCHEDULE MATERIAL.—The present stock situation is fair, but the future causes anxiety. Factory stock orders are severely apportioned and are dribbled out in altogether inadequate quantities.

RANGES.—A few spasmodic and scattered sales efforts continue, but no regular campaigns have survived the recent price advances. Single sales by dealers rather than concerted sales by central station are the rule. Deliveries are very poor.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

Armored Conductor, Flexible Steel

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
	No. 12 Solid
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

Twin-Conductor

	No. 14 Solid
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
	No. 12 Solid
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	5%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	5%

Twin-Conductor

	No. 14 Solid
Less than coil	$90.00 to $104.00
Coil to 1000 ft	85.00 to 95.00
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	5%

Attachment Plugs

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20% to list
1/5 to std. pkg	List to 20%
Std. pkg	25% to 36%

Batteries, Dry

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.40	.40
50 to barrel	.36	.37
Barrel lots	.329	.339

Batteries, Dry—*Continued*

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.362	.372
Barrel lots	.332	.342

Conduit, Metallic Flexible

Size, In.	Ft. per Coil	List per 100 Ft.
3/8	250	$5.00
1/2	250	7.50
3/4	100	10.00
1	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
3/8-in. single trip	$75.00	$53.75— 69.75
3/8-in. double strip	75.00— 82.50	72.00— 75.00
1/2-in. single strip	100.00	85.00— 93.00
1/2-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
3/8-in. single strip	$75.00	$63.25 to $63.75
3/8-in. double strip	78.25	71.25
1/2-in. single strip	100.00	75.00 to 85.00
1/2-in. double strip	105.00 to 109.00	93.00 to 95.00

Conduit, Non-Metallic Flexible

Size, In.	List per Foot	Size, In.	List per Foot
3/8	$0.05 1/2	1	$0.25
1/2	.06	1 1/4	.33
3/4	.09	1 1/2	.40
3/4	.12	1 3/4	.47
3/4	.15	2	.55
3/4	.18	2 1/2	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
3/8-in.—	$35.00	$27.50	$26.50
1/2-in.—	35.00	30.00	29.00

NET PER 1000 FT.—CHICAGO

	Less than 250 ft.	250 to 2500 ft.	2500 to 10,000 ft.
3/8-in.—	$48.00	$27.75	$26.00
1/2-in.—	$52.00	30.50	28.25

Conduit, Couplings and Elbows, Rigid Iron

Card No. 42

Size, In.	Conduit, List per Foot
1/4	$0.08 1/2
3/8	.08 1/2
1/2	.08 1/2
3/4	.11 1/2
1	.17
1 1/4	.23
1 1/2	.27 1/2
2	.37 1/2
2 1/2	.58 1/2
3	.76 1/2

Conduit, Couplings and Elbows, Rigid Iron—*Continued*

Size, In.	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.50
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	1% to 12.1%	3% to 14.1%
2500 to 5000 lb.	6% to 15.1%	8% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/4 to 1/2 In.	3/4 to 3 In.
Less than 2500 lb.	+3% to 3.1%	2% to 2.1%
2500 to 5000 lb.	+1% to 5.1%	4% to 7.1%

(For galvanized deduct six points from above discounts.)

Flatirons

NEW YORK

List price	$6.75 to $7.50
Discount	25%

CHICAGO

List price	$6.75 to $7.50
Discount	25% to 30%

Fuses, Inclosed

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40%

Fuse Plugs

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

Lamps, Mazda or Tungsten

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg	List
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg	List
Std. pkg	10%

Lamp Cord

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$28.60–$35.01
Coil to 1000 ft	25.74– 29.17

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$23.50–$32.00
Coil to 1000 ft.	23.50

Lamp Guards, Wire

Standard packages from 50 to 150

NEW YORK

Net per 100	$29.70 to $33.00

CHICAGO

Net per 100	$29.70 to $33.00

Outlet Boxes

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4It, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%–38%	20%–33%
$10.00 to $50.00 list	36%–47%	31%–43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	33%	24%–25%
$10.00 to $50.00 list	45%	32%–37%

Pipe Fittings

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

Porcelain Cleats—Unglazed

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$17.85 to $22.40
1/5 to std. pkg	14.70 to 15.35
Standard package, 2200. List per 1000.	$21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg	$18.00 to $18.90
1/5 to std. pkg	15.00 to 15.75
Standard pkg., 2200. List per 1000.	$20.00 to 21.00

Porcelain Knobs

NEW YORK

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid	Nail-it—N.C.
Less than 1/5 std. pkg	$13.60–$15.00	$22.00–$22.40
1/5 to std. pkg	10.50– 11.20	15.35– 18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid	Nail-it—N.C.
Less than 1/5 std. pkg	$14.40	$28.00
1/5 to std. pkg	12.00	23.00

Sockets and Receptacles

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20 to list
1/5 std. pkg	List to 10%

Switches, Knife

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T	$0.80
60-amp. S. P. S. T	1.20
100-amp. S. P. S. T	2.25
200-amp. S. P. S. T	3.48
300-amp. S. P. S. T	5.34
30-amp. D. P. S. T	1.20
60-amp. D. P. S. T	1.78
100-amp. D. P. S. T	3.38
200-amp. D. P. S. T	5.20
300-amp. D. P. S. T	8.00
30-amp. 3 P. S. T	1.80
60-amp. 3 P. S. T	2.68
100-amp. 3 P. S. T	5.08
200-amp. 3 P. S. T	7.80
300-amp. 3 P. S. T	12.00
Low Grade:	
30-amp. S. P. S. T	$0.42
60-amp. S. P. S. T	.74
100-amp. S. P. S. T	1.50
200-amp. S. P. S. T	2.70
30-amp. D. P. S. T	.68
60-amp. D. P. S. T	1.22
100-amp. D. P. S. T	2.50
200-amp. D. P. S. T	4.50
30-amp. 3 P. S. T	1.02
60-amp. 3 P. S. T	1.84
100-amp. 3 P. S. T	3.76
200-amp. 3 P. S. T	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%
$10 to $25 list	+10%
$25 to $50 list	+5%
	Low Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%

Switches, Snap and Flush

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

Switches, Snap and Flush—*Continued*

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	23%

Switch Boxes, Sectional Conduit

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%–20%	List–18%
$2.00 to $10.00 list	28%–30%	5%–28%
$10.00 to $50.00 list	45%–50%	10%–47%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	15% to 25%	25% to 30%
$2.00 to $10.00 list	15% to 25%	25% to 30%
$10.00 to $50.00 list	25%	25% to 30%

Toasters, Upright

NEW YORK

List price	$6.25 to $7.00
Discount	25%

CHICAGO

List price	$7.50
Discount	25% to 30%

Wire, Annunciator

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.52
No. 18, full spools	.51

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.54 to $0.57
No. 18, full spools	48 to .51

Wire, Rubber-Covered, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$16.00	$13.00	$13.00
12	21.78	21.78	18 15
10	31.18	27.67	22.64
8	42.12	38.77	31.64
6	61.16	55.60	50.04

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$25.00	$14.00	$12.50–14.00
12	30 00	19 00	19.00
10	35.77	35 77	30.66
8	42.84	42 84	36.72
6	67.80	67 80	56 50

Wire, Weatherproof

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$35 00
25 to 50 lb	35.00
50 to 100 lb	34.00

CHICAGO

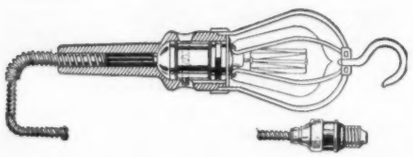
	Per 100 Lb. Net
Less than 25 lb	$33.00
25 to 50 lb	33 00
50 to 100 lb	33.00

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Portable Extension Fixture with Armored Cable

A portable extension lamp, known as "Steelite Industrial Special No. 403," has been brought out by the Inland Electric Company of 15 North Franklin Street, Chicago, and has as one of its features 25 ft. (7.6 m.) of cable armored in reinforced steel, which resists the hard surfaces, rough points and ragged edges so prevalent in industrial plants without interfering with the flexibility of the fixture, which can be pulled in, out, over and under machinery without kinking or catching.

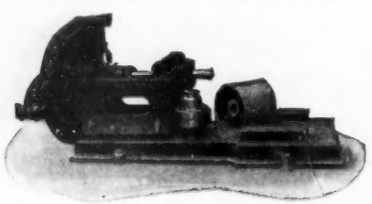


DOUBLE-ACTION PUSH-BUTTON IN HANDLE

The new fixture has a lamp guard equipped with a hook for hanging. This guard opens easily for insertion of the lamp bulb. The handle, which is of wood, contains a double-action push-button switch. When desired the new lamp can be supplied with a reflector for concentrated lighting.

Centrifugal Pump for Interchangeable Drive

The particular features of the type B centrifugal or volute pump which has recently been brought out by the Pelton Water Wheel Company, Nineteenth and Harrison Streets, San Francisco, Cal., for general utility and irrigation use, are its overhung pulley construction and the standardized interchangeability of the method of drive. With this type of construction and heavy cast-in bearing journals, it is possible to drive the same pump without danger of strains either by a belt or directly connected to the motor. The pulley may be replaced with the flexible couping, or vice versa, simply by loosening the countersunk set screw on the pulley or coupling, making the change and tightening the screw.



PULLEY OR FLEXIBLE COUPLING DRIVE EQUALLY APPLICABLE

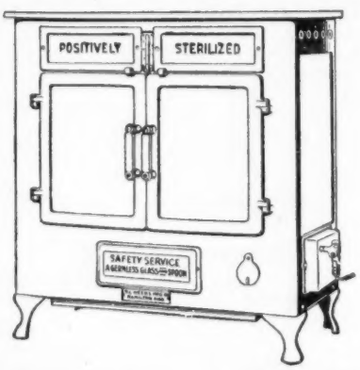
The pumps are horizontal, single-suction volute pumps of the inclosed impeller type, adaptable for either right-hand or left-hand operation.

Miniature Electric Aeroplanes

Two miniature aëroplanes operated by motor-driven propellers and which are attached to the ceiling and fly in circles are recent additions to the products of the A. E. Rittenhouse Company of Honeoye Falls, N. Y. They may be used as toys or as advertising devices in show-window displays.

Electrically Heated Hot-Air Sterilizer

Automatic sterilizers using electrically heated hot air have been placed on the market by the H. G. Weeks Manufacturing Company of Hamilton, Ohio, in various sizes and styles for use by soda fountains, physicians, surgeons, dentists, oculists, bacteriologists and laboratories. Efforts have been made to make these sterilizers automatic, simple and fool-proof in operation. The trays of glasses, spoons, instruments, etc., are inserted in the sterilizer, the doors closed, a lever pushed, and the sterilization process begins. Thermostats which may be set to trip at any desired temperature automatically control the temperature of the sterilizers. It is stated that these sterilizers, which use freshly heated air, do not break glasses or injure instruments, nor are the articles left streaked as sometimes happens when sterilizing is done by steam. As a result of heavy insulation, the outside of these sterilizers, it is claimed, remains at about room temperature, even though the temperature of the inside exceeds 300 deg. Fahr. (150 C.).

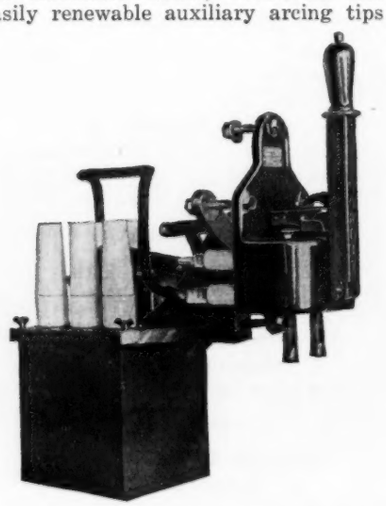


STERILIZES 600 GLASSES AND 600 SPOONS IN AN HOUR

Oil Switch and Circuit Breaker

For controlling and protecting feeder circuits, transformer banks, generators, etc., where a moderate interrupting capacity is required, the Condit Electrical Manufacturing Company, South Boston, Mass., has developed type E-3 oil switch and circuit breaker. All of the automatic forms of these switches may be provided with undervoltage, shunt trip and a time-limit attachment. Auxiliary switches of the circuit-opening and circuit-closing type may also be utilized in connection with either the non-automatic or the automatic form. The automatic form may be furnished in series trip for 200 amp., 2500 volts, and in non-automatic, current-transformer or relay trip for 300 amp. or less at 4500 volts.

All automatic-type overload circuit breakers have their trip coils and calibration adjustments on the front of the switchboard, and the mechanism is arranged to prevent the operator from holding the switch closed during an overload or short circuit. Other important features of these switches are the laminated brush, reversible and easily renewable auxiliary arcing tips and the self-aligning sure-seating action between the movable-contact members and the stationary-contact members, the rugged tank construction, high



FOR USE WHERE MODERATE INTERRUPTING CAPACITY IS REQUIRED

head of oil over break, large expansion chamber and strong spring action in the brushes, which facilitates rapid acceleration of the movable contact members on the initial opening of the circuit.

Alternating-Current Demagnetizer

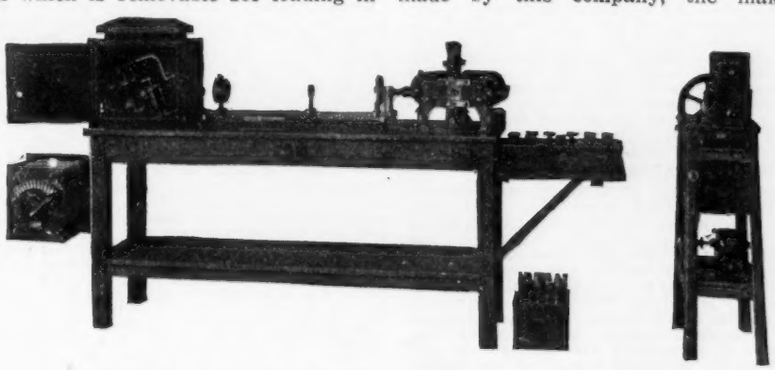
Bars of steel 4 in. (10 cm.) long and 2 in. (5 cm.) thick can be as easily demagnetized, the W. Green Electric Company of 81 Nassau Street, New York City, declares, as watches, tweezers, screwdrivers or drills by using its type 36 automatic alternating-current demagnetizer.

When the demagnetizer has been connected by a plug to a lamp socket on an alternating-current circuit of 100 to 115 volts, 60 cycles, it is ready for immediate use. The article to be demagnetized is placed completely through the coil and the current turned on by pressing a button. Then the article is withdrawn to arm's length and immediately the power is turned off.

Electrocardiographic Equipment

The essential parts of the electrocardiographic equipment recently developed by Charles F. Hindle of 106 East 126th Street, New York, are the galvanometer and the photographic recorder. The necessary accessories include illuminating apparatus, special switchboard and compensating resistance boxes. A device for marking off short intervals of time on the records is included, and there are numerous minor accesories such as storage batteries, switchboards, etc. This apparatus is especially desirable for laboratories and for clinical hospital use.

The photographic recorder or camera is mounted on a substantial wooden stand and is so constructed that the apparatus may be used in a moderately light room. The film, 200 ft. (60 m.) long and 2½ in. (6 cm.) wide, is wound on a roll and slipped into a box which is removable for loading in the dark room. This spool film is driven by a worm-geared motor through a separate shaft mounted on ball bearings, a balance wheel being used to aid in maintaining a uniform feed of the photographic material.



MEASURES AND RECORDS THE ACTIVITIES OF THE HUMAN HEART

Shunt-Wound Low-Voltage Dynamo

For light and moderate work, such as plating and laboratory service, its types 18 and 18A shunt-wound low-voltage dynamos are now being manufactured by the W. Green Electric Company of 81 Nassau Street, New York City. Type 18 dynamo is wound for 12 amp. and type 18A for 20 amp., both being for 6 volts, but they are adjustable and the voltage may be increased to 8 or decreased to 1 as desired. They each have a net weight of 15 lb. (6.8 kg.).

Portable High-Frequency Machine for Medical Use

In order that high-frequency energy may be available for medical use in different wards of a hospital or in other places which do not have stationary machines, the Wappler Electric Company, 173 East Eighty-seventh Street, New York City, has placed upon the market its portable "Telatherm," a high-frequency machine which can be carried about from patient to patient.

STIMULATES GRANULATION

It generates D'Arsonoval and Oudin currents similar in quality and smoothness to those of the larger machines made by this company, the maker says, and possesses the same nicety of control. However, it is not provided with special cold cautery terminals, neither is it intended for auto-condensation. It is valuable for the all-vacuum treatments, fulguration, both unipolar and bipolar, and diathermia.

The machine is procurable only for 110-volt alternating current of 60 cycles; where direct current only is available a suitable rotary converter can be used. It is contained in a substantial waxed-oak carrying case 15½ in. (39 cm.) high by 13¾ in. (34 cm.) wide by 8¾ in. (22 cm.) deep, and weighs 40 lb. (18 kg.).

Unit for Department-Store Lighting

To obtain both correct quality and correct quantity of illumination for showing fabrics to their best advantage was the purpose of the Mitchell Vance Company, 503 West Twenty-fourth Street, New York City, in designing the new lighting unit for department stores which it is now manufacturing.

The graceful lines of the fixture make it highly harmonious with the general artistic appearance of a high-class department store. The mechanical structure of the unit is strong and durable and a maximum amount of ventilation has been provided for, the maker says. The "Celestialite" glass globe is said to be designed, both in shape and construction to produce a "next-to-daylight" quality of illumination when used in connection with a gas-filled lamp.

The new unit is also eminently suitable, the maker states, for offices and public buildings where high-efficiency light with total absence of glare is desired. It is made in various sizes for use with gas-filled lamps of from 75 watts to 500 watts.

NOTES ON RECENT APPLIANCES

Pipe Fittings with Composition Bushings

The Adapti Company of Cleveland, Ohio, has placed on the market a line of pipe fittings with composition bushings.

Arc-Weld Bonding Machine

An electric arc-welding machine that is useful in shop work as well as in rail bonding has been developed by the Ohio Brass Company of Mansfield, Ohio.

Farm Light and Power Plant

A farm light and power plant in which the engine is separate from the generator is being made by the John Lauson Manufacturing Company of New Holstein, Wis.

Automatic Electric Range

An electric range in which the cooking is automatically regulated has been announced by the Hughes Division of the Edison Electric Appliance Company, 5660 West Taylor Street, Chicago, Ill.

Manufacturers' Activities

THE WARD LEONARD ELECTRIC COMPANY, Mount Vernon, N. Y., is building a two-story addition to its factory.

THE AMERICAN TRANSFORMER COMPANY, Newark, N. J., has prepared plans for alterations and improvements in its plant, estimated to cost $5,700.

THE STAR ELECTRIC SUPPLY COMPANY has filed notice of organization to operate at 268 Market Street, Newark, N. J., for the production of electrical supplies. S. Torster, 88 Seymour Avenue, heads the company.

FRANK T. GROOME has resigned as sales manager of the Benjamin Electric Manufacturing Company of Canada, Ltd., Toronto. He is now carrying on a business of his own as manufacturers' agent at 119 Fairview Avenue.

THE DICKEY STEEL COMPANY, INC., Woolworth Building, New York City, has been appointed sales representative for the New York and Philadelphia districts of the Worcester Pressed Steel Company, manufacturer of electrical sheet steel.

THE BELDEN MANUFACTURING COMPANY, Chicago, whose new plant in that city was described on page 500 of the Aug. 30 issue of the ELECTRICAL WORLD, is located at Kilpatrick Avenue, Congress Street, Van Buren Street and the Belt Railroad of Chicago.

THE CHICAGO MICA COMPANY, Valparaiso, Ind., has recently employed L. T. Frederick as consulting engineer and production manager. Mr. Frederick was formerly process engineer of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

THE LUX MANUFACTURING COMPANY, 121 East Kinney Street, Newark, N. J., manufacturer of tungsten lamps, has arranged for a bond issue of $100,000 for proposed expansion. The company has secured property adjoining its present works for the erection of an addition at a later date.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, recently declared a two-dollar quarterly dividend on both preferred and common shares. Previous dividends were one dollar on both classes. Increased earnings resulted in the increased dividend, according to an official statement.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has arranged for the erection of a new one-story addition to its plant at Nineteenth and Willard Streets. Contract for the structure, which will be about 32 ft. by 97 ft. and is estimated to cost $14,000, has been awarded.

THE TAYLOR INSTRUMENT COMPANIES, Rochester, N. Y., show an increase in number of employees as common stockholders in the last two and one-half years. From Dec. 31, 1916, to June 30, 1919, the total number of holders of common stock increased from forty-nine to eighty-three, while during that same period the employee stockholders increased from seventeen to forty-five.

THE PAGE & HILL COMPANY, pole producer, Minneapolis, Minn., announces that J. E. Lynch has returned to the company and has taken over the management of the Chicago office. He served in France with the 311th Engineers. Sig Norman has also returned after twenty months' service in France with the 20th Engineers. Mr. Norman was on board the Tuscania when it was sunk. He is assistant manager of the Newport (Wash.) office.

THE WESTERN ELECTRIC COMPANY has acquired 50 acres of land at Norfolk, Va., on which to provide a plant for the manufacture of submarine cable. It is expected that at a later period other products will be manufactured at this place. The new property, having a frontage on the southern branch of the Elizabeth River, opposite the Portsmouth Navy Yard, has the deep-water facilities that will make it ideal for the shipment of submarine cable. The construction of the plant will be started within a short time. The consideration for the property is said to be about $200,000.

THE DYNETO ELECTRIC CORPORATION, Syracuse, N. Y., manufacturer of electric specialties for automobile service, is planning a one-story addition, 70 ft. by 200 ft., to cost $50,000.

THE GEORGE SACHENMAIER COMPANY, dealers in new and used electrical machinery, has moved to its new office building at 926 North Third Street, Philadelphia, adjoining the warehouse.

THE EASTERN SIGNAL & SUPPLY COMPANY, 30 Church Street, New York, manufacturer of storage batteries, has leased space in Boonton, N. J., covering approximately 5000 sq.ft. for a new establishment.

THE VICTORIA ELECTRIC SUPPLY COMPANY, LTD., Toronto, announces that it is now manufacturing its own line of conduit fittings. A complete stock of all sizes will be carried at the Toronto, Montreal and Halifax warehouses.

THE UNION ELECTRIC SUPPLY COMPANY, Providence, R. I., announces recent changes of executives as follows: President M. F. Falk; secretary, W. L. Adams; treasurer, S. A. Jenks. Paul K. Craig has been appointed manager of the appliance and specialty department.

CHARLES E. MERRILL, for the past ten years general purchasing agent for the Manhattan Electrical Supply Company, New York City, is acting as general manager for the Parr Electric Company, wholesale and export electrical supplies, recently formed at 77 Warren Street, New York City.

PENNSYLVANIA ASSOCIATION EXHIBIT.—Feeling that eventually the conventions of the geographic sections of the National Electric Light Association will take the place of the great convention of the N. E. L. A., so far as the interests of operating men and commercial men are concerned, the exhibition committee of the Pennsylvania Electric Association arranged a tent on the grounds of the Bedford Springs Hotel, Bedford Springs, Pa., in which for the first time a display of electrical apparatus and appliances was made a definite part of the convention proper. The success of the plan was such as to make the exhibit idea a permanent one, and it is very likely that the other geographic sections will copy it. The following

EXHIBIT AT PENNSYLVANIA ASSOCIATION CONVENTION

is a list of the exhibitors: Commercial Truck Company of America, Philadelphia; H. C. Roberts Electric Supply Company, Philadelphia; entertainment committee; Electro Dynamic Company, Bayonne, N. J.; Electric Service Supplies Company, Philadelphia; American Conduit Manufacturing Company, Pittsburgh; Philadelphia Electric Company Supply Department, Philadelphia; Westinghouse Electric & Manufacturing Company, East Pittsburgh; Westinghouse Lamp Company, New York City; Railway & Industrial Engineering Company, Greensburg, Pa.; Metropolitan Engineering Company, Brooklyn, N. Y.; Ohio Brass Company, Mansfield, Ohio; Western Electric Company, Pittsburgh; Elliott Fisher Company, Harrisburg, Pa.; Iron City Electric Company, Pittsburgh; Rumsey Electric Company, Philadelphia; Ludwig Hommel & Company, Pittsburgh; Pittsburgh Transformer Company, Pittsburgh; General Electric Company, Schenectady, N. Y.; Hubbard & Company, Pittsburgh; Hoover Suction Sweeper Company, North Canton, Ohio; Pittsburgh Gage & Supply Company, Pittsburgh; Doubleday-Hill Electric Company, Pittsburgh; *Electrical Review*, Chicago.

THE DRIVER-HARRIS COMPANY, Harrison, N. J., has filed plans for the erection of a new three-story reinforced-concrete building, about 50 ft. by 100 ft., at its plant. The structure will cost about $50,000.

GOLDENBERG BROTHERS, Baltimore, Md., manufacturer of electric and gas fixtures, etc., have completed arrangements for the purchase of property at 717-21 North Gay Street, for new manufacturing works.

E. L. SULLIVAN has been appointed to represent the Green Engineering Company in the Pittsburgh district, including western Pennsylvania, eastern Ohio and western West Virginia. Mr. Sullivan has been a special representative for the McDonough Regulator Company for the past ten years in Chicago and Pittsburgh. He has devoted all of his time to special investigations pertaining to the securing of more efficient boiler and furnace operation. Mr. Sullivan will maintain the company's present offices at 2545 Oliver Building, Pittsburgh, where he will serve in all matters pertaining to the sale of Green chain-grate stokers, sealflex arches, steam-jet ash conveyors, cast-iron ash tanks and replacements for the same.

THE SIGNAL ELECTRIC MANUFACTRING COMPANY, Menominee, Mich., has been incorporated with a capital stock of $150,000 to take over the Menominee interests of the Tideman Electric Manufacturing Company, which has recently completed a factory at Cairo, Ill. Henry Tideman, president, will devote his attention to the Cairo works. His sons, Harold and William Tideman, in association with Charles D. Hammond, George Fussner and Fred A. Roper, have organized the Signal company as a separate enterprise, operating the former Tideman plant in Menominee. The products include electric fans, blowers and other industrial and domestic appliances and devices. The officers of the new corporation are: President, Ralph W. Wells; vice-president, John E. Henes, Jr.; secretary and treasurer, Charles E. Hammond.

EDWARD C. RILEY has been appointed New England sales manager of the Edison Storage Battery Company, with headquarters at 702 Beacon Street, Boston. He succeeds George W. Holden, who recently left the company's service. Mr. Riley is a native of Lawrence, Mass., and was graduated in the scientific course from Dartmouth College in 1916. For about a year he was a sales representative of the Hyatt Roller Bearing Company, with headquarters in the Cleveland district. When the United States entered the was he enlisted in the navy as a second-class seaman and soon was assigned to a course at the United States Naval Acadamy. In the fall of 1918 he was on destroyer service in the war zone with the rank of lieutenant, junior grade, being a survivor of the collision between the destroyer Shaw and the Cunarder Aquitania. On return to civilian life he was employed in the home office and New York district of the Edison battery company until his transfer to Boston.

Supply Jobbers' Notes

A. G. NABORS, who has been with the Western Electric Company since 1905, is now central district manager of pole-line material. He was formerly at New York, Philadelphia and Pittsburgh.

W. H. SPENCER & COMPANY, LTD., electrical supplies and manufacturers' agents, have removed from 340 University Street to 213 Notre Dame Street, West, Montreal. The company intends carrying a more extensive line of electrical supplies.

THE INTERSTATE ELECTRIC COMPANY, New Orleans, La., has purchased property on which to erect three modern brick and concrete buildings, ten, fifteen and three stories high, to care for its expanding business. Construction will begin as soon as building conditions justify, according to Mr. Stern, the president. At the present time the company is adding a story and a half to the building it occupies at Barone Street. The electrical appliance and automobile trade in the South and with the Latin-American countries has grown to such proportions that expansion is imperative, and the undertaking is to create a single concern which will supply all branches of the trade. According to Mr. Stern, two new companies subsidiary to the principal company will be formed, one for the St. Charles Avenue establishment and the other for the export trade to be conducted at Lafayette and Dryades Streets.

Foreign Trade Notes

BRITISH IMPORT RESTRICTIONS STILL ON ELECTRICAL PRODUCTS.—Import restrictions still hold on illuminating glassware and magnetos, classified among unstable key industries. The key industries have been excepted in the general license, issued under date of Sept. 1, authorizing importation into the United Kingdom of all goods.

SWEDISH ELECTRICAL EQUIPMENT PRODUCTION.—The following figures are given in Swedish export returns for the production in Sweden of electrical machinery, apparatus and transmission appliances: 1897, $1,350,000; 1907, $5,000,000; 1913, $8,150,000; 1914, $8,500,000; 1915, $11,500,000; 1916, $18,000,000; 1917, $26,200,000. To a large extent, of course, this rapid growth since 1914 may be accounted for by advancing prices.

RESUMPTION OF TRADE WITH HUNGARY.—The War Trade Board announces that, effective Sept. 2, the resumption of trade and communication between the United States and Hungary has been authorized. Exports from the United States to Hungary will be controlled by individual export licenses, but such licenses will be issued freely upon application, except with respect to the following commodities, whose exportation will be restricted for military reasons: Electrical appliances adapted for use in war and their component parts, searchlights and their component parts, and submarine sound signaling apparatus and materials for wireless telegraphs.

STANDARDIZATION OF ELECTRICAL APPARATUS IN ENGLAND.—According to Trade Commissioner Powell, London, it seems that, although extreme individualism has always had a marked effect upon English industrial life, probably the most conspicuous example of lack of standardization is to be found in electrical appliances. In London, for example, one cannot purchase a simple electric bulb without specifying the particular type of socket to be used. A universal design would seem to be the first essential if a wide market is desired. The Board of Trade committee on the electrical trades advocated the amalgamation, or at least the association, of the various companies engaged in the industry and continued: "By association it would be possible to manufacture each class of apparatus in the most suitable factory, the management of which would thus be concentrated on its own specialty instead of being wasted on a variety of products. It is essential that output should be thus consolidated instead of remaining in the hands of a number of weak concerns, many of which, moreover, have further reduced their competitive power by dabbling in a variety of productions. An important advantage resulting from such combination would be the extension of standardization, which the committee considers is of the highest importance from a national as well as from an international point of view.

ELECTRICAL GOODS NEEDED BY ITALY.—Acording to the consul at Milan, letters are received daily from local concerns which want to sell on a commission basis decorated glassware, vacuum cleaners and electrical goods of American manufacture.

J. A. BLICKMAN, who has been in the employ of the Westinghouse Electric & Manufacturing Company for a number of years, is leaving for Holland, where he is going into partnership with his brother. He expects to sell Westinghouse appliances and equipment.

VENEZUELA CHANGES TARIFF ON ELECTRICAL APPARATUS.—By two decrees of May 10 and May 12 the Treasury Department has made the following changes in tariff classifications: Repair parts for electric automobiles are now in the first class and pay duty of 69 cents per 100 lb. gross; in the fourth class, paying duty of $10.27 per 100 lb., gross, are electric massaging apparatus, shades of copper, iron or other ordinary metal for electric lamps and shades of glass or porcelain for electric lamps.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An agency is desired by a man in Italy (No. 30,556) for the sale of electrical supplies. Correspondence may be in English.

A merchant in Italy (No. 30,526) desires to be placed in communication with firms for the sale of electrical instruments. Correspondence may be in English.

A firm in Russia (No. 30,520) desires to establish connections with American firms for the purchase of electrical machinery and supplies, telephone and telegraph supplies.

A commercial agent (No. 30,533) with a warehouse in France desires to secure agencies for the sale of electric lighting apparatus. Correspondence should be in French.

The representative of a commercial body in Persia (No. 30,530) is in the United States for a short time and wishes to purchase and also make agency arrangements for telephone equipment.

A merchant in Greece (No. 30,454) desires to be placed in communication with exporters with a view to securing an agency for the sale in the Near East of electrical machinery of all kinds and electric wires. Correspondence may be in English.

The representative of a firm in Spain (No 30,552) is at present in the United States and wishes to secure an agency for the sale of electric machinery, material for central generating stations, small electric material, pumps, turbines and lamps.

Electric lighting plants, electric fans (table, wall and ceiling), especially sing e phase, three-cycle, 115-volt ceiling fans, and hydraulic turbines are required by a firm in India (No. 30,434). Quotations should be given f.o.b. New York. Payment, telegraphic transfer on New York with order.

Albert B. Singer of the Leland-Giorgi Company, 1133 Broadway, New York City, importers and exporters, desires to secure connections with American manufacturers dealing in telephone apparatus, electric meters, water meters, refrigerating apparatus and electrical supplies. The main office of the above company is in Florence, Italy, and the desire is to secure Italian representation of American manufacturers of the listed equipments.

Rafael Montiel Balanzat, general manager of Ortega y Montiel, engineers, 25 Lorrilla, Madrid, Spain, will be in the United States for the next two months to arrange for the handling of American-made electrical machinery and wiring equipment in Madrid. His address in this conutry is Biltmore Hotel, New York City. He is prepared to pay cash until he has established his credit with American houses. It is probable that at this time he will also arrange for the purchase of a limited amount of electrical material.

Trade Publications

NICKEL. — The International Nickel Company, 43 Exchange Place, New York City, has issued a booklet telling about its nickel products.

PLASTIC ARC WELDING.—The Wilson Welding Repair Company, Ltd., 2 Rector Street, New York City, has issued a booklet about the repairs made by its electric welders.

DRY STORAGE BATTERIES.—A folder has been issued by the U-Need-It Dry Storage Battery Company of New York City to present the advantages of its dry storage battery.

FLOODLIGHTING PROJECTORS.—A booklet on floodlighting projectors has been issued by the Electric Service Supplies Company, Seventeenth and Cambria Streets, Philadelphia, Pa.

STORAGE BATTERIES.—The Edison Storage Battery Company, Orange, N. J., have issued bulletin No. 600 of thirty-eight pages telling about its storage batteries for industrial transportation purposes.

INCANDESCENT LAMPS.—The Lux Manufacturing Company, 123 East Kinney Street, Newark, N. J., has issued a booklet containing prices, engineering data and general information about Lux lamps.

PROTECTIVE RELAYS.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is distributing publication No. 1572-A about its protective relays and their use on alternating-current systems.

BAFFLE WALLS FOR BOILERS.—"The Development of an Idea" is the title of a booklet recently issued by the Engineer Company of New York City, containing a description of the construction and application of Turner baffle walls for boilers.

WATER STERILIZATION.—A twenty-four-page booklet has been published by J. B. Clow & Sons, 534 Franklin Street, Chicago, and has for its subject ultra-violet-ray water sterilization for drinking water, swimming pools and other commercial and domestic purposes.

New Incorporations

THE KYLE (TEX.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $7,500. H. B. Jones is interested in the company.

THE LOGANSPORT (IND.) UTILITIES COMPANY has been incorporated with a capital stock of $60,000 by Oliver H. Binns, Frank B. Wilkinson and others.

THE DAYTON (OHIO) FAN & MOTOR COMPANY has been incorporated by E. O. Waymire, C. C. Miners and others. The company is capitalized at $700,000.

THE CANE CREEK TELEPHONE & LIGHT COMPANY of Fairview, N. C., has been incorporated with a capital stock of $10,000. R. B. Williams is among the incorporators.

THE LIVE WIRE COMPANY of Guelph, Ont., has been incorporated by Charles L. Dunbar, Leo W. Goetz and others. The company is capitalized at $100,000 and proposes to manufacture insulated wire, etc.

THE DETROIT (MICH.) SPARK PLUG MANUFACTURING COMPANY has been incorporated by Philip E. Moody, Chauncey P. Watson and Paul B. Moody. The company is capitalized at $10,000 and proposes to manufacture spark plugs and accessories for automobiles.

THE BERHOLME POWER COMPANY of New Berlin, N. Y., has been incorporated with a capital stock of $25,000 to operate an electric light and power plant in South New Berlin. The incorporators are T. B. Parker, F. Van Valkenburg and E. W. Hovey, all of South New Berlin.

THE AMERICAN ELECTRIC MOTOR COMPANY of Milwaukee, Wis., has been organized by Carl L. Daum, Walter N. Sprinkmann and Harry B. Mortimer, all of Milwaukee. The company is capitalized at $175,000 and will make electric motors, etc.

New Engiand States

RUTLAND, VT.—The Rutland Railway, Light & Power Company has been awarded a contract by the Tauber-Lipton Company to furnish electricity to operate its new plant.

NEW BEDFORD, MASS.—The Holmes Manufacturing Company is contemplating the erection of a large transformer house.

BOSTON, MASS.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Sept. 30 for construction of senior medical officers' quarters, junior medical officers' quarters, nurses' and pharmacists' quarters, attendants' quarters, tuberculosis pavilion and approaches for the United States Marine Hospital, Boston, Mass., including plumbing, heating, electric work, etc. Further information may be obtained from the custodian or at the above office.

TAUNTON, MASS.—The Bay State Street Railway Company has submitted a proposal to the Electric Light Commissioners offering to supply such extra power as may be needed by the city.

WORCESTER, MASS.—The New England Power Company has petitioned the Board of Gas and Electric Light Commissioners for permission to issue $600,000 in bonds and $350,000 in bonds, the proceeds to be used for new extensions.

WESTERLY, R. I.—The New England Silk Company is planning a new power plant in connection with the proposed addition to its works, to cost about $150,000.

BRIDGEPORT, CONN.—Fletcher-Thompson, Inc., engineers, 1089 Broad Street, it is reported, will receive bids about Sept. 20 for the construction of a cold-storage and ice-manufacturing plant on Seaview Avenue for the People's Ice & Cold Storage Company, to cost about $350,000.

BRIDGEPORT, CONN.—Contract has been awarded by the Bryant Electric Company for the erection of an addition, 60 ft. by 220 ft., to its plant on Hancock Street, to William Martin & Sons of Bridgeport. The company manufactures electric switches and other electrical products.

EAST NORWALK, CONN.—Plans are being prepared by Fletcher-Thompson, Inc., engineers, 1089 Broad Street, Bridgeport, for the erection of two factories and also a power plant, 60 ft. by 300 ft., on Van Zandt Avenue, for Crofut & Knapp, Water Street, South Norwalk. The cost of the work is estimated at about $500,000.

NEW BRITAIN, CONN.—Bids are being taken, it is reported by Landers, Frary & Clark, for the construction of an addition, 50 ft. by 160 ft., six stories, to its plant. The company manufactures electric heating and cooking appliances, metal products, etc.

NEW HAVEN, CONN.—Preliminary work is being done on the power house for the estate of Edward Malley to furnish light, heat and power for the Edward Malley stores on Chapel and Temple Streets and the Malley Estate property, on the corner of Chapel and Temple Streets. The Larkin Carey Company has the contract for the construction of the building. Westcott & Mapes, engineers, are to design the equipment for the power house and have charge of the work.

Middle Atlantic States

BINGHAMTON, N. Y.—The Board of Supervisors is considering a proposal submitted by the Binghamton Light, Heat & Power Company to extend its transmission lines to furnish electricity to the new Tuberculosis Hospital at Chenango Bridge.

BROOKLYN, N. Y.—Contract has been awarded by the New York Telephone Company, 15 Dey Street, New York City, to the Gillies Campbell Company, 101 Park Avenue, New York City, for the construction of a new telephone exchange building at Liberty Avenue and Milford Place, to cost about $200,000.

BUFFALO, N. Y.—The Niagara, Lockport & Ontario Power Company, it is reported, is contemplating raising the dam of the Salmon River Power Company storage reservoir at Redfield by 25 ft.

GLENS FALLS, N. Y.—The Adirondack Electric Power Corporation has petitioned the Public Service Corporation for permission to take over the plant and holdings of the Kanes Falls Electric Company, which supplies electricity in the towns of Queensbury, Kingsbury, Fort Ann and Granville, N. Y., and Wells and Poultney, Vt.

MARCY, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until Oct. 7 for construction, including heating, sanitary and electric work, of a central heating, lighting and power plant at the Utica State Hospital (Marcy Division), Marcy, N. Y. Drawings and specifications may be obtained at the Department of Architecture, Capitol, Albany. Drawings and specifications may be consulted at the Utica (N. Y.) State Hospital, at the New York Office of the Department of Architecture, Room 618, Hall of Records Building, and at the Department of Architecturs, Albany. F. L. Pilcher, Capitol, is state architect.

NEW YORK, N. Y.—Plans, it is reported, are under consideration by the Columbia Graphophone Company, Woolworth Building, for the establishment of new plants for the manufacture of talking machines at Newark, N. J., for the New York district, at Philadelphia, Pa., and at Baltimore, Md. The main plant of the company is at Bridgeport, Conn. Francis S. Whitten is president.

FREEHOLD, N. J.—The Board of Freeholders of Monmouth County has engaged C. A. Slocum, engineer, Long Branch, to prepare plans for a new heating and lighting plant, to cost about $25,000.

BELLEFONTE, PA.—The Public Service Commission has granted the State Centre Electric Company, which operates in Bellefonte, State College and other towns in this vicinity, permission to issue $474,000 in bonds for extensions and improvements to its system.

CLEARFIELD, PA.—The Public Service Commission has granted the Penn Public Service Company permission to issue $4,867,700 in capital stock, for extensions and improvements to its system.

COLUMBUS, PA.—The Borough Council has authorized a contract with the Edison Electric Company of Lancaster for lighting the streets for a period of five years from Oct. 1, 1919. Under the new contract the company is to replace the arc lamps now in use with Mazda lamps of 400 cp. Orders, it is understood have been placed for the fixtures.

PHILADELPHIA, PA.—Plans have been filed by the Electric Storage Battery Company, Nineteenth and Allegheny Streets, for the erection of an addition to its plant at Nineteenth and Willard Streets, to cost about $14,000.

RUSSELLVILLE, PA.—A company has been formed in Russellville to construct and operate an electric light and power plant. Raymond Webster is president and E. P. Maule is treasurer of the company.

WILKES-BARRE, PA.—According to bids submitted for changing the electric lamps standards on East Market Street, Public Square and North Main Street from five-globe type to one-globe, the cost will be from $10,000 to $15,000.

BALTIMORE, MD.—Preparations are being made by the Baltimore County Water & Electric Company for the construction of a pumping station at Towson, to cost about $15,000.

CUMBERLAND, MD.—Contract has been awarded by the Kelly-Springfield Tire Company of Akron, Ohio, for the construction of the entire plant at Cumberland, with the exception of the operating machinery, to the Hankinson-Conkey Company of Cleveland. The cost of the plant complete is estimated at several million dollars.

WASHINGTON, D. C.—Bids will be received at the office of the chief of engineers, room 2729, Munitions Building, Washington, D. C., until Sept. 26, for furnishing miscellaneous quantity of watertight lighting fixtures.

WASHINGTON, D. C.—Bids will be received at Machinery and Engineering Materials Division, Room 1824, Munitions Building, Washington, D. C., until Sept. 29, Circular 46, for furnishing 4,500 ft. of lead-covered cable.

WASHINGTON, D. C.—Bids will be received by the Machinery and Engineering Materials Division, Room 1824, Munitions Building, Washington, D. C., until Sept. 29 for furnishing 43 miles of submarine cable. For information refer to M. E. 47.

WASHINGTON, D. C.—Bids will be received by the Machinery and Engineering, Materials Divisions, Munitions Building, Washington, D. C., until Sept. 22, Circular 45, for furnishing 6000 guy thimbles and 1000 guy thimbles.

WASHINGTON, D. C.—Bids will be received at the Army Constructoin Division, Washington, D. C., until Sept. 23 for furnishing, under Proposal 205, lighting fixtures for Schofield Barracks, H. T. For further information address the above office.

WASHINGTON, D. C.—Bids will be received at the office of the chief of engineers, Room 2729, Munitions Building, Washington, D. C., until Sept. 24 for furnishing 5825 cable hangers, 4,000 brass expansion bolts, 800 expansion bolts, 50 expansion bolts and 250 expansion shields.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., some time in the future, under Specification 3708, for furnishing and installing turbine-driven pumps, feed-water heaters, five-notch meter, filters, forced-draft fan and forced-draft duct, boiler flues, storage tank, extension to coal conveyor, coal chute, coal gate, coal weigher and piping and appurtenances in boiler plant at the local navy yard. A deposit of $20 will be required for plans.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until Sept. 23, New Orleans, La., Schedule 4540—1550 lb. of copper tubing Eastern and Western yards, Schedule 4538—leaded and armored cable. Until Sept. 26, Washington, D. C., Schedule 4536—storage batteries. South Brooklyn, N. Y., Schedule 4554—thirty ships' telephones. Until Sept. 30, Mare Island, Cal., and Puget Sound, Wash., Schedule 4515—250 electric pumps. Until Oct. 3, Eastern and Western yards, Schedule 4553—complete switchboards. Washington, D. C., Schedule 4564—three electric elevating trucks; Schedule 4573—20,000 ft. rubber-insulated and braided wire; Schedule 4574—cable. Application for proposal should designate the schedule desired by number.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

North Central States

DETROIT, MICH.—Plans are being prepared by the Detroit Edison Company for the erection of a two-story substation on Conners Creek Road, near Six-Mile Road, to cost about $40,000.

LANSING, MICH.—Electrical equipment, to cost about $40,000, has been ordered by the city of Lansing, which will be used to connect the municipal electric plant with the power plant of the Michigan Power Company, recently taken over by the city.

CANTON, OHIO.—The United Electric Company is considering extensions to its plant.

CLEVELAND, OHIO.—Bids will be received at the office of the Commissioner of Purchases and Supplies, City Hall, Cleveland, Ohio, until Sept. 26 for series-multiple transformers. Bids will also be received at the same time and place for electric meters. Specifications may be obtained upon application to Room 204, City Hall.

CLEVELAND, OHIO.—Bids will be received at the office of the commisssioner of purchases and Supplies, City Hall, Cleveland, until Sept. 26, for forty-six signal place for 57 miles of hard-drawn No. 12 also be received at the same time and place fo r57 miles of hard-drawn No. 12 weatherproof copper wire for the police signal system.

LEBANON, OHIO—The City Council has engaged E. M. Chace, Union Central Building, Cincinnati, to take charge of the engineering work in connection with the proposed new municipal electric light plant, for which $120,000 in bonds were recently voted.

LIMA, OHIO.—The Ohio Steel Foundry Company is planning to erect a new building, to cost about $200,000. It is proposed to install a machine-charged furnace and an electrically operated crane, with span of 100 ft.

VALPARAISO, IND.—Contracts will soon be awarded by the Condon Company structural and industrial engineers, 53 West Jackson Boulevard, Chicago, Ill., for the erection of a plant for the McGill Manufacturing Company, to cost about $150,000. The McGill company manufactures electrical specialties.

CHICAGO, ILL.—The Walker Vehicle Company, Wabash Avenue and Thirty-ninth Street, has purchased a site at State and Eighty-seventh Streets, on which it is proposed to erect a new plant. The company manufactures electric vehicles.

CHICAGO, ILL.—An issue of $16,000,000 in bonds for improvements to the street-lighting system is being advocated by William G. Keith, commissioner of gas and electricity. The proposed bond issue would completely equip the city and provide for a five-year plan of extension, besides giving an extra million for rehabilitating the police and fire-alarm system. The plans provide for replacing all gas lamps now in use with electric lamps.

GALESBURG, ILL.—The City Council has passed an ordinance authorizing the installation of an ornamental lighting system on Chambers, Losey, Willard and Bateman Streets, to cost about $20,000.

PANA, ILL.—The coal-tipple and surface equipment at the Springside mine of the Smith-Lohr Coal Mining Company was recently destroyed by fire, causing a loss of about $300,000.

ROCK ISLAND, ILL.—The plant of the Universal Tractor Works, owned by the Moline Plow Company, will be rebuilt. The machine shops were recently destroyed by fire, causing a loss of about $150,000.

AMERY, WIS.—Plans have been prepared for the installation of an ornamental lighting system in the business district.

CRANDON, WIS.—Contract has been awarded to the Johnson Electric Company of Wausau for the erection of a high-tension electric transmission line from the plant of the Rhinelander (Wis.) Light & Power Company to Crandon.

FORT ATKINSON, WIS.—Plans are being prepared by the James Manufacturing Company for the erection of an addition, 150 ft. by 400 ft., to cost about $200,000. Considerable machinery, including an electric traveling crane and other equipment, will be required. J. G. Shodron is manager.

KAUKAUNA, WIS.—The Oconto River Public Service Company, recently incorporated by Charles H. Hartley, 400 Algoma Street, Oshkosh, and others, is planning to build a hydroelectric power plant on Oconto River in the spring of 1920.

KEWAUNEE, WIS.—The Wisconsin Shipbuilding & Navigation Corporation, 216 West Water Street, has engaged McMullen & Pitz, consulting engineers, Manitowoc, to prepare plans for the establishment of its proposed steel shipyard at Kewaunee, which will include power plant, machine shop, woodworking shop and other buildings. E. T. Thomas is president and chief engineer.

RACINE, WIS.—Contract has been awarded by the Racine Rubber Company for the construction of an addition to its plant, to cost about $100,000. The company, it is reported, is purchasing new electric motor, power and tire-manufacturing equipment. Stuart H. Webster is vice-president and general manager.

FAIRMONT, MINN.—The generating plant of the municipal electric plant has been closed down and electricity for the local system is purchased from the Sioux Falls (S. D.) division of the Northern States Power Company.

MONTICELLO, IOWA.—Improvements are being made at the plant of the Monticello Electric Company, including the installation of two 112-kva. vertical-type generators and two vertical-type turbine waterwheels. The cost is estimated at about $20,000.

KANSAS CITY, MO.—The Premier Tire & Rubber Company is considering the purchase of new equipment, including motors, transformers, hydraulic boiler-feed pumps, air compressors, presses, gages, buffers, etc.

MARSHALL, MO.—Bonds to the amount of $46,000 have been voted for the installation of a municipal electric light plant.

CARSON, N. D.—An election will soon be called to submit to the voters the proposal to issue bonds for the installation of a municipal electric light plant in Carson.

GUIDE ROCK, NEB.—The installation of an electric light system in Guide Rock is under consideration.

WAKEFIELD, NEB.—The Wakefield (Neb.) Electric Company has petitioned the State Railroad Commission for a certificate of convenience and necessity.

ARLINGTON, KAN.—Bonds to the amount of $20,000 have been voted for the installation of a municipal electric light plant. Electricity to operate the system will be obtained from Hutchinson.

BENDENA, KAN.—The installation of an electric lighting system in Bendena is under consideration.

MULVANE, KAN.—The electric plant of the Mulvane Ice & Cold Storage Company has been taken over by the city of Mulvane, and bonds for it have been voted.

Southern States

FORT GAINES, GA.—The local electric plant, owned by the Cridelle-Fowler Company, has been purchased by the Georgia-Alabama Power Company. The new owners will enlarge the plant and build another dam across the Patsula Creek near Cridelle Mill. It is proposed to increase the output of the power station 125 hp. to 800 hp. or 1000 hp. and to extend the transmission lines to several Georgia and Alabama cities. The cost of the work is estimated at about $250,000. The Hardaway Construction Company of Columbus, Ga., is contractor.

SPRINGFIELD, GA.—At an election to be held Sept. 23 the proposal to issue $10,000 in bonds for the installation of lighting and water systems in Springfield will be submitted to the voters.

WINTER GARDEN, FLA.—Bonds to the amount of $8,000 have been voted for improvements to the municipal electric light plant.

LEXINGTON, MISS.—The contract for construction of the proposed municipal electric lighting system has been awarded to Williams & Lebby of Yazoo City.

NORTH LITTLE ROCK, ARK.—The Arkansas Light & Power Company of Little Rock has applied to City Council for a franchise to erect electric lines on several streets in the city.

SPARKMAN, ARK.—The City Council has granted B. H. Fulkerson of Pangburn a franchise to install and operate an electric lighting system in Sparkman. Mr. Fulkerson will also install an ice plant.

SPRINGDALE, ARK.—The city of Springdale is considering the installation of lighting, sewer and water systems, to cost about $200,000. Frank L. Wilcox, Syndicate Trust Building, St. Louis, Mo., is consulting engineer.

FARGO, OKLA.—The installation of a municipal electric light plant and waterworks system, to cost about $26,000, is under consideration.

HOOKER, OKLA.—Plans are under consideration for the installation of an electric light plant, to cost about $40,000.

MIAMI, OKLA.—The installation of an ornamental lighting system in the business district is under consideration.

MINCO, OKLA.—Improvements are contemplated to the municipal electric light plant and waterworks system, to cost about $11,000.

NOWATA, OKLA.—The City Council has engaged Burns & McDonnell, engineers, Interstate Building, Kansas City, Mo., to prepare plans for improvements to the municipal electric light plant and waterworks system.

PONCA CITY, OKLA.—Bonds to the amount of $50 000 have been voted for improvements to the municipal electric light plant.

SHAMROCK, OKLA.—Arrangements have been made by the Oklahoma Electric & Power Company, which is erecting an electric transmission line from Muskogee to Sapulpa, Drumright and west, to take over the local electric light plant and system.

DALLAS, TEX.—The Henry Exall Elrod Company, engineers, it is reported, would like data and estimates of cost on a 3500-kva. steam-driven electric generating plant.

LYFORD, TEX.—The Stevenson Motor Company, it is reported, contemplates the installation of an electric plant to supply electricity for a city of 3000 or less. A. W. Stevenson is president.

SAN AUGUSTINE, TEX.—The City Council is considering taking over the local electric light plant, for which bonds have been voted. Improvements will be made to the power plant, including the installation of generators and other equipment.

SAN JUAN, TEX.—Improvements are contemplated to the municipal electric light plant.

WICHITA FALLS, TEX.—The People's Ice Company is planning to build a new ice plant of 50 tons daily capacity, to cost about $125,999.

Pacific and Mountain States

COLFAX, WASH.—The Washington Water Power Company is contemplating erecting a heavier transmission line to Colfax this fall, at a cost of about $28,000.

EVERETT, WASH.—The City Commissioners have engaged R. E. McDonnell of the firm of Burns & McDonnell of Kansas City, Mo., to collect data relative to the installation of a municipal electric light plant in Everett.

SEATTLE, WASH.—Mayor Fitzgerald, recently elected, has announced that bids will soon be called for the installation of a 10,000-kw. generator at the Cedar Falls plant and for the construction of the new pipe line from the dam to the power house. It is also proposed to replace the present frame structure in which the power plant is housed for a fireproof building. The City Council has authorized $1,755,000 in bonds for the proposed work.

TACOMA, WASH.—At a special election held recently the proposal to purchase the Lake Cushman power site was carried.

BALBOA CAL.—The Southern California Edison Company has applied for permission to erect two transmission lines across the Balboa Channel at Balboa.

FRANKLIN, CAL.—Plans have practically been completed by the Great Western Power Company of San Francisco to erect a 22,000-volt transmission line from Hood to Franklin. A substation will be erected here to distribute electricity in the town. The cost of the work is estimated at $20,000.

VISALIA, CAL.—The installation of an electrolier lighting system in the business district is under consideration.

HARDIN, MONT.—Contract has been awarded for laying contract for conduits for the proposed ornamental lighting system to be installed in the business district.

ROUNDUP, MONT.—The Montana Power Company of Butte has purchased the property of the Roundup Electric Company and proposes to erect a transmission line from Harlowton to supply electricity for the local system.

WINNEMUCCA, NEV.—The Winnemucca Water & Light Company contemplates extensions to its system and relaying its feeder lines, at a cost of about $25,000.

Canada

GODERICH, ONT.—The Lake Huron Steel Company is contemplating the construction of a large electric steel plant at Goderich. An expenditure of $2,000,000 is planned for the first twelve months, and the total for blast furnaces for the second year is placed at $6,000,000. The present plans provide for the installation of six electric furnaces of the Heroult type, the erection of a blowing mill, rod mill and bar mill.

HANLEY, SASK.—Bids will be received by A. Holm, secreary and treasurer of the town of Hanley, until Sept. 24 for machinery and material as follows: A—For furnishing and erecting one internal-combustion engine; B—for furnishing and installing one generator, exciter, switchboard, transformer, meters, etc.; C—for furnishing one oil storage tank; D—for furnishing poles, wire and line material; E—for erection of pole line; F—for erection of power station and cooling chamber. Plans and specifications may be seen at the office of A. Holm, secretary and treasurer, Hanley, and at the office of Murphy & Underwood, consulting engineers, Saskatoon, Sask.

KRYDOR, SASK.—The installation of an electric light plant in Krydor, to cost about $30,000, is under consideration. Joseph Moody of Krydor is reported interested in the project.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Sept. 25 for furnishing cable, pipe and fittings, valves, locks, nuts, cocks, hardware, storage batteries, tires and tubes, etc. Blanks and information relating to this circular (1305) may be obtained from the above office.

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Sept. 25 for furnishing, under Circular 1305, cable, wrought-iron pipe, pipe fittings, bushings, tees, unions, storage batteries, tubes and casings, etc. Bids will also be received at the same place until Oct. 4, under Circular 1306, for furnishing incinerator plant, telephone exchange, metal furniture, panelboards, outlet boxes, cable condulets, storage batteries, steel bars, etc. For further information address the above office.

PEARL HARBOR, H. T.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Oct. 22 (Specification 3856) for power-plant equipment at Pearl Harbor. The cost is estimated at about $80,000.

Record of Electrical Patents

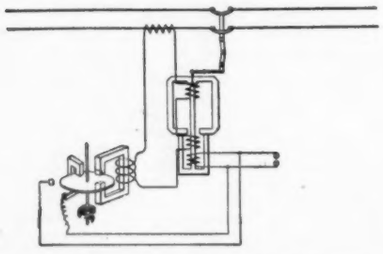
Notes on United States Patents

(Issued August 26, 1919)

1,314,470. AUTOMATIC CUT-OUT SWITCH; Abel Fernandez, Washington, D. C. App. filed March 2, 1918. Prevents overloading of lines.

1,314,471. MAXIMUM-DEMAND CONTROLLER AND LOAD INDICATOR FOR ELECTRIC POWER INSTALLATIONS; C. Gow, London, Eng. App. filed Nov. 30, 1918. Combination of a clock, an ergmeter and two indicators.

1,314,483. DEFINITE TIME-LIMIT RELAY; Reginald J. C. Wood and George E. Armstrong, Los Angeles, Cal. App. filed March 5, 1918. Mechanical in its action and applied without modification of circuit breaker.



1,314,508—Electrical Protective Device

(Issued Sept. 2, 1919)

1,314,501. SYSTEM OF CONTROL; Aubrey L. Broomall, Wilkinsburg, Pa. App. filed Nov. 6, 1915. Control of electric railway motors that are adapted to regeneration.

1,314,508. ELECTRICAL PROTECTIVE DEVICE; Almon W. Copeley, Wilkinsburg, Pa. App. filed July 5, 1917. For tripping circuit interrupters.

1,314,515. AUTOMATIC SWITCHING DEVICE FOR ELECTRIC METAL-WORKING APPARATUS; James H. Gravell, Brooklyn, N. Y. App. filed Oct. 24, 1918. Mechanism controls the duration of welding current.

1,314,517. CONTROL SYSTEM; Rudolf E. Hellmund, Swissvale, Pa. App. filed Sept. 8, 1914. Variable resistor for regenerative systems.

1,314,524. AUTOMOBILE STARTING SWITCH; Bayard D. Kunkle, Wilkinsburg, Pa. App. filed April 6, 1914. Prevents use by unauthorized persons.

1,314,530. RELAY; Paul L. Mardis, Wilkinsburg, Pa. App. filed July 6, 1917. For protecting electric light circuits.

1,314,576. CARTRIDGE FUSE PLUG; Charles Dawson and Edward E. Morgan, Belvidere, Ill. App. filed May 4, 1918. Automatically binds electrical connecting parts in plug together.

1,314,581. CIRCUIT-INTERRUPTING DEVICE; Robert D. Evans, Wilkinsburg, Pa. App. filed Sept. 16, 1918. Has no movable parts.

1,314,583. FUSE INDICATOR; Frederick A. Feldkamp, Newark, N. J. App. filed May 16, 1918. Can be attached to fuse to show when it has been blown.

1,314,592. SYSTEM OF ELECTRICAL DISTRIBUTION; Peter Cooper Hewitt, Ringwood Manor, N. J. App. filed July 11, 1911. Vapor apparatus for the rectification of alternating current of relatively large power.

1,314,593. DIRECTIVE WIRELESS TRANSMISSION; Peter Cooper Hewitt, Ringwood Manor, N. J. App. filed Dec. 2, 1915. Receives on its own wave length and sends by a number of others.

1,314,594. ELECTRIC BATTERY; Major E. Holmes, Lakewood, Ohio. App. filed Feb. 25, 1918. Dry cell lining having cereal flour distributed throughout its mass.

1,314,603. ELECTRODE COATING; William Roy Mott, Lakewood, Ohio. App. filed Jan. 14, 1919. Multiple coating of non-solvent metals for carbon or graphite electrodes.

1,314,610. ELECTRICAL MEASURING APPARATUS; Irving B. Smith, Ambler, Pa. App. filed March 6, 1918. To determine setting of movable-coil galvanometer of the D'Arsonval type.

1,314,617. TELAUTOGRAPHIC SYSTEM; George S. Tiffany, Summit, N. J. App. filed July 22, 1916. Prevents heating of pen-moving coils and eliminates distortions or reproductions.

1,314,618. TELAUTOGRAPHIC APPARATUS; George S. Tiffany, Summit, N. J. App. filed Sept. 10, 1915. Diminishes the effect of induction.

1,314,619. TELAUTOGRAPHIC APPARATUS; George S. Tiffany, Summit, N. J. App. filed Sept. 10, 1915. Eliminates ink-carrying pen and ink-well heretofore used.

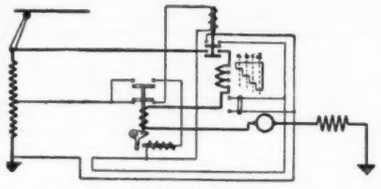
1,314,620. TELAUTOGRAPHIC APPARATUS; George S. Tiffany, Summit, N. J. App. filed Sept. 10, 1915. Improved means for moving receiving tracer.

1,314,629. THERMOSTATIC CONTROL FOR ELECTRIC BATTERIES OF AUTOMOBILES, ETC.; John F. Andrews, Los Angeles, Cal. App. filed Jan. 21, 1919. Automatically reduces charging current for given temperature.

1,314,632. PROCESS FOR THE ELECTROLYTIC TREATMENT OF CARBON; Arthur R. Bullock, Cleveland, Ohio. App. filed Oct. 2, 1914. Carbon removed from electrode and incorporated in the electrolyte.

1,314,671. ELECTRIC STERILIZER; Charles J. Koehler, Hamilton, Ohio. App. filed April 17, 1919. Employs switch rod, spring and lost-motion coupling.

1,314,674. ELECTRIC WELDING TONGS; Henry F. Kuntzmann, Brooklyn, N. Y. App. filed Nov. 26, 1918. Insulated tongs will hold special shapes.



1,314,530—Relay

1,314,685. TRUNKING ARRANGEMENT FOR AUTOMATIC TELEPHONE EXCHANGES; Talbot G. Martin, Chicago, Ill. App. filed May 29, 1905. Employs step-by-step switching machines.

1,314,695. COMPOSITE SIGNALING CIRCUITS; Harold S. Osborne, New York, N. Y. App. filed June 8, 1917. Two-way, two-repeater circuits used.

1,314,703. ELECTRIC SIGNALING DEVICE; Ralph R. Root, Cleveland, Ohio. App. filed July 19, 1915. Vibrated by electromagnet energized by alternating current.

1,314,711. AUTOMATIC TELEPHONE SYSTEM; Arthur B. Smith, Evanston, Ill. App. filed March 25, 1916. Exchanges interconnected by long-distance lines.

1,314,721. APPARATUS FOR TRANSMITTING AND RECORDING MESSAGES; Henry Warmick and Annetta Warmick, Grand Rapids, Mich. App. filed Nov. 1, 1918. Obtains written record of messages.

1,314,720. IGNITION SYSTEM; Richard Varley, Englewood, N. J. App. filed June 28, 1918. Magnets recharged without removing either magneto or permanent magnets.

1,314,724. ELECTRIC CONDUCTOR SUPPORT; Dorsey G. Winchester, Pruden, Tenn. App. filed Aug. 19, 1918. Transmits current to trolley wire.

1,314,738. AUTOMOBILE; Roland S. Fend, Chicago, Ill. App. filed July 11, 1917. Regulating current of motor.

1,314,742. ELECTROLYTIC PROCESS; William E. Greenawalt, Denver, Col. App. filed Jan. 19, 1914. Impure copper sulphate solutions used.

1,314,778. AUTOMATIC TELEPHONE SYSTEM; Bernard D. Willis, Chicago, Ill. App. filed Feb. 28, 1916. Superimposed simplex circuits.

1,314,789. RADIO-TELEGRAPHY SYSTEM; Frank Conrad, Swissvale, Pa. App. filed June 5, 1916. Controls circuits without interrupters.

1,314,804. TELEPHONE SYSTEM; John E. Hilbish, La Grange, Ill. App. filed March 15, 1915. Disconnect and recall for cord circuit.

1,314,840. COMPOSITION FOR ELECTROLYTES FOR ELECTRICAL ETCHING; Joseph H. Weeks, Rutledge, Pa. App. filed April 30, 1917. Employs acetates.

1,314,841. COMPOSITION FOR ELECTROLYTES FOR ELECTRICAL ETCHING; Joseph H. Weeks, Rutledge, Pa. App. filed April 30, 1917. Tartrates used.

1,314,842. COMPOSITION FOR ELECTROLYTES FOR ELECTRICAL ETCHING; Joseph H. Weeks, Rutledge, Pa. App. filed April 30, 1917. Employs nitrates.

1,314,871. APPARATUS FOR THE FUSION OF REFRACTORY MATERIALS; Ralph A. Hoyle, Worcester, Mass. Furnace for artificial abrasive alundum.

1,314,881. HEAT-REGULATING SYSTEM; Edwin N. Lightfoot, New York, N. Y. App. filed Oct. 10, 1916. Maintains constant crucible temperature.

1,314,893. COMPOSITION FOR ELECTROLYTES FOR ELECTRICAL ETCHING; Joseph H. Weeks, Rutledge, Pa. App. filed April 30, 1917. Borates used.

1,314,894. CONTROLLING MEANS FOR ENGINE STARTERS; Henry G. O'Neill, New York, N. Y. App. filed March 1, 1915. Spark advancing and retarding device.

1,314,895. ALTERNATING-CURRENT DISTRIBUTING SYSTEM; John C. Parker, Ann Arbor, Mich. App. filed Jan. 29, 1917. Interconnected network prevents interruptions.

1,314,908. SPARK OBSERVER; Emmett M. Sims, Louisville, Ky. App. filed Dec. 21, 1918. Adjustable and movable.

1,315,029. ELECTROPLATING APPARATUS; David A. Metz, Philadelphia, Pa. App. filed Sept. 21, 1918. Refining by agitation.

1,315,032. STORAGE-BATTERY ELECTRODE; Albert L. Muren, Burlington, Iowa. App. filed May 28, 1918. Maximum surface exposed for given weight.

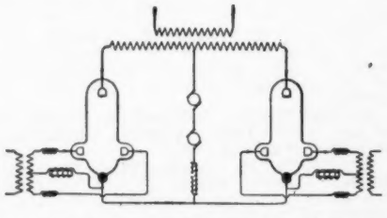
1,315,049. PORTABLE STREET SIGNALING DEVICE; Daniel C. Stickrath, Omaha, Neb. App. filed March 29, 1919. Remote-controlled stop and go signals.

1,315,135. TERMINAL PROTECTOR; Michael La Rocco, Chicago, Ill. App. filed March 15, 1919. Shield from fumes of battery.

1,315,162. ELECTRIC FUSE; John Schneider, Elizabeth, N. J. App. filed July 25, 1918. Fuse wire extends into arc-extinguishing medium.

1,315,168. AUTOMOBILE SIGNAL; Hampton K. Smith, Union, S. C. App. filed May 16, 1917. Tail-lamp indication of direction.

1,315,172. ELECTRICAL SOLDERING IRON; Emil Stranszky, Dover, Ohio. App. filed May 27, 1918. Permits of ready removal and replacement of parts.



1,314,592—System of Electrical Distribution

1,315,182. ELECTRIC SWITCH; Abner F. H. Davis, Oakland, Cal. App. filed Aug. 22, 1916. Interrupts spark-plug circuit on automobile metal released by combination setting of dials.

1,315,197. WIRELESS TRANSMISSION OF ENERGY; Earl C. Hanson, Los Angeles, Cal. App. filed Sept. 7, 1915. Waves at audio frequency instead of radio frequency.